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Davis S. Goyer

Odyssey Studios FB. *Spotlight on **Ciarán Cooke**, manager at **Odyssey Studios**, on working on Foundation

1. Chris MacLean & Mike Enriquez – VFX Supervisors - The Art of VFX

05/10/2021

In 2019, Chris MacLean had explained to us the work done by Mr. X on The Highwaymen. Mike Enriquez has over 20 years of experience in visual effects. He worked for many years at Stargate Studios and then at DNEG before joining Skydance.

How did you get involved on this project?

Chris MacLean // I had just finished season two of American Gods. The day before I flew to LA for the premiere, Michael Malone called me. We'd worked on The Highwaymen and Godless together. He said he had just been hired to produce Foundation and needed a VFX Supervisor who he could trust with something like this and would be a good collaborator. I was looking for my next project and had a few coals in the fire, but knowing how great my experience was on the two projects we did together he set up an interview for me at Skydance. Now, I love Sci-Fi but most of my ingestion of the genre is through film, TV and video games. I'll be the first to admit that I had never read Foundation or Asimov prior to that call from Michael. Toronto to LA is kind of a long flight so I picked up a copy of the first book and read it on the flight to LA. My first impression was that it deals with big ideas and the characters discuss those ideas but you never really saw what was happening. Not going to lie, I thought it was going to be something like Law & Order or The West Wing in space.

The day after the Gods premiere I went to the Skydance offices and spoke with Matt Ariail, Carol Turner and Dieter Ismagil. We had a great conversation about the show and they set up an interview with David Goyer.

They gave me the first script and I left to fly back to Toronto. Before my flight, I dropped in on my mentor and friend, the late, great John Swallow. We had become close over those years we had worked together. Neither of us knew this would be the last time we would see each other but I'll forever be grateful I got to see him one last time. We talked about the projects I had lined up and who was involved. I'll always remember what he said, "I can't tell you what to do but you should do what scares you the most." We talked for a few more hours and I left for LAX. On the flight home I read David's script for episode one and was blown away. To my mind, he had cracked the nut that was how to make Foundation in a visual medium. At that moment I was hooked. A few days later I spoke with David, we hit it off right away and we got to work.

Mike Enriquez // I was finishing work on Westworld and Picard when COVID hit and production slowed down. I was starting to look for work when I received a call from Addie Manis, the VFX producer on Foundation. The show was huge and could use some help wrangling vendors and guiding shots to completion. With nearly 4000 shots in play, it was far too much work for one person. So after talking to Chris and David, I was brought on.

What was your feeling to be involved in such an iconic project?

Chris MacLean // It was exciting and nerve racking. We had most of the scripts and they were awesome, but dense. We knew we had a monumental task ahead of us. I was the second hire on the show behind Michael Malone. We were looking for a Production Designer, trying to build out a team and find Directors. You can imagine the difficulty of finding the right people for a project like this. Most people thought Foundation was too big of a story to take on. Everyone thought it was too expensive. How were we going to create all these worlds? How were we going to make it different? How were we going to tell a story that spans a thousand years? All of these questions hung over us for months.

Once Rory Cheyne was on board as the Production Designer the show took off like a rocket. We had worked together on season 2 of American Gods and I knew he had just finished Locke and Key. Michael, Rory and I spent most of the summer of 2019 on planes scouting locations, trying to flesh out the world David had written and was still writing. Iceland, Ireland, Germany, Spain, LA, back to Iceland, back to Toronto…there were a lot of flights. The whole time Rory and I were drawing and tossing ideas back and forth. We were up against a clock. The three of us dubbed it *Foundation: The No Sleep Tour.*

It took some time to get Rupert Sanders on board but once we had our pilot Director we were able to answer a lot of our questions. The nervous excitement turned to process and execution.

Mike Enriquez // Honestly, I couldn't believe it at first. And then I thought it was beyond me. But with a lot of hard work and great creative partners it all came to fruition.

How was the collaboration with the showrunner and the directors?

Chris MacLean // David is one of the most collaborative people I've had the pleasure of working with. If you have ideas he'll listen, and if they are good ideas he'll use them. If he doesn't like your ideas, he'll tell you and you move on. We have a great working relationship and we trust each other.

We had six directors on Foundation, Including David. Rupert Sanders was our first Director. If you've seen his films you know he has a great eye for design and concept. He wasn't used to coming into a show without his people, so Rory and I had to build trust with him. We eventually won him over and ended up having a great time with him. We spent a lot of time previsING with Rupert and locking in the look of the series.

Andrew Bernstein directed episode two. Very solid director and very collaborative. He had a very steady hand.

Alex Graves was our director for three, four and five. I'll be honest, I was warned that Alex didn't have an affinity for VFX. All I have to say is don't believe everything you hear. Once you understand his process he's very easy to get along with. He is an amazing Director and crafted some of the most beautiful episodes in the season.

Jennifer Phang directed episode six and seven. She had some of the most complex and conceptually difficult episodes of the season. We spent a lot of time together going over storyboards, previs and animatics to get her heavy VFX scenes dialed in. Really got to know her well over the course of the show. She was a great collaborator as well.

Roxanne Dawson directed eight and nine. She is an amazing director and very solid on the floor. She has a great understanding of visual effects and how to shoot Sci-Fi.

David directed episode ten and he was just as collaborative as a director as he is as a showrunner. We worked through a ton of animatics and previs for his episode. He had a great process. Boards were always up on location or on set. Everyone knew what we were doing when we were shooting David's episode.

Mike Enriquez // As Chris mentioned, David has been great to work with. It's always a collaborative discussion, with no ideas off limits.

What was their approach and expectations about the visual effects?

Chris MacLean // The expectations were astronomically high for Foundation. We were inventing a new Sci-Fi visual language. What does FTL travel look like? What does the Vault look like? How do you visualize math in an interesting way? How do you make a planet look like it is completely covered in water? How do we do this within the budget limitations and not run out of money after the first episode? I know that everyone is saying the show looks like the most expensive thing on TV but there are shows out there that have less episodes, shorter runtimes and have much bigger budgets than us.

We had to be creative and diligent with our methodology. My mantra was "keep it in camera until you can't." We knew we had these giant VFX sequences to execute and if we wanted them we couldn't blow our budget on volume heavy shot types like set extensions or cleanup. We would look at the script and if there was a dialogue heavy scene I would target those for in camera sequences. Rory gave us great sets and found locations that lent themselves to this technique. The Directors and David had to buy into this as well. For the most part, we pulled it off. We employed techniques like using longer lenses and blocking shots so that we were shooting into the location or set. If we weren't able to avoid this sort of secondary VFX shots we would reduce the number of cuts in an edit to bring the shot count down. We still had our fair share of these types of shots to do but if we hadn't set out in the beginning to avoid this sort of thing we wouldn't have made it past episode one budgetary. I think this method also helped the show, in that the VFX didn't overpower the practical elements of the show and it forced us to find practical locations rather than shooting the whole thing against greenscreen.

From the outset I had a very good idea of how to execute the show from a visual effects standpoint but also wanted to pay homage to Sci-Fi that came before us. I wanted to look at melding practical and digital elements in an elegant way. That's where we decided to shoot miniatures and cloud tank elements as a starting point. We brought Ian Hunter on to help us realize this. We wanted to design shots that felt grounded in reality and the best way to do that was to actually shoot them. Mark Maher and his team at Odyssey Studios built the FTL ship, The Rubicon, The Aegis and The Beggar's Lament under Ian's supervision. Ian then brought in a motion control team and Les Bernstein to shoot the miniatures. For me, it was amazing to learn about this process and to be a part of it. These guys are truly dedicated artists and I loved every minute of it. In the end, the footage of the ships were invaluable as shot elements but also as reference for the full CG ship shots.

I should also mention that we did use some LED volumes on the show. Knowing the limitations of the technology, i.e. you can't focus on the panels without getting moire, angular color shift, only being able to shoot with one camera at a time… not to mention the lead time to create the content, we chose to look for targets of opportunity to employ the tech. A good example of this was the elevator ride and fall in episode one. Chris Keller and the team at DNEG, created content for us that we played back for the actors and DPs. It was great for interactive lighting and reflections. In cases like this we knew we would have to replace the background. Another good example of where the LED volume worked well was the intimate mountainscape scene in episode two with Raych and Gaal. We set up an LED wall in Ireland that we played back footage on from time lapse plates I shot at Hekla in Iceland. We had very little cleanup to do on those scenes and are 99.5% in camera save for a bit of floor cleanup.

Mike Enriquez // Just to add to what Chris wrote, yes, the visual needs for this show were very complex. The show had to look real, but also beautiful and non-evocative of other sci-fi properties. There was as much scrutiny given to composition and color palette as there was given to technical fidelity. More than once I was told by a vendor that we are scrutinizing the finishing of the FX work more than the blockbuster features they work on.

And as Chris mentioned, the reviews keep talking about huge or unlimited budget, which was not the case. We worked tirelessly to get as much production value out of what we had to work with as possible. Time and money were constant obstacles.

How did you organize the work between you two and with your VFX Producer?

Chris MacLean // Addie Manis, the VFX Producer, was based in LA with post and I was in Europe for the shoot. The time difference made communication difficult and we realized I needed someone with me on the ground. Pre-Covid we brought on Sarah Vinson as on-set VFX Producer to help with the day to day while Addie managed the budget and vendors back in the US. When Covid hit I came back to Toronto. Addie and I continued to work with the vendors remotely during this time. When we came back during Covid, it was difficult to travel to Europe from America, so we brought on Victoria Keeling as our on set VFX Producer. Around this time Apple asked if we could deliver early so we brought on Mike Enriquez as our Post-VFX Supervisor to get through the volume of shots. He became a great creative partner for me on the show. Kathy Chasen-Hay, the Senior VP of Visual Effects at Skydance, also played a huge role in helping get this behemoth project across the finish line.

It really and truly was a team effort and everyone involved deserves credit for their part in making the show happen.

How did you choose the various vendors?

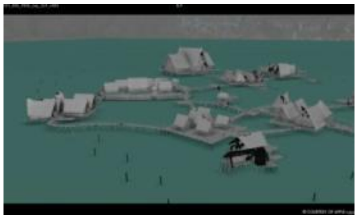
Chris MacLean // We developed early relationships with ILP, DNEG, Mackevision, Scanline VFX, Mr. X, Outpost VFX, Chicken Bone FX and Bot. Tendril in Toronto came on early to help with design. These were vendors with solid creative teams and we knew that they could take the brunt of the work. When Covid hit, the whole industry was under immense strain. Shooting had been halted worldwide and the fear of the unknown put a lot of strain on the vendors, along with the rest of the world. There were furloughs, there were layoffs, there were forced wage reductions… a lot of people reassessed their work/life balance and left the industry outright. To put it bluntly, Covid created a labor shortage and we needed help. Thankfully Rodeo FX had capacity and was the first vendor to join the show post Covid. Then we were able to bring Crafty Apes, BUF, Rocket Science, Spin VFX and WhiskeyTree to help fill out the rest of the vendor side team. It was truly a VFX vendor effort of epic proportions and I'm truly grateful that we were able to find so many talented artists to help us.

Can you tell us how you split the work amongst the vendors?

Chris MacLean // Forgive me if I forget anything…

- Odyssey FX in Ireland built the miniatures of the ships.
- Hires Lighting in Ireland did the LED hardware and content playback.
- Tendril designed the Prime Radiant, the Psychohistory math and what we call Sandograms, which are particle based holograms.
- ILP was responsible for the Synnax sequences and almost all of the water work.
- DNEG was our volume vendor and did most of the heavy lifting. They were responsible for the majority of the Vault sequences, FTL travel sequence, Starbridge collapse, the Invictus, the Raven Math/Holograms, Trantor City establishers and the Imperial Palace sequences. They also executed the Psychohistory math shots and did the bulk of the Sandograms.
- Mr. X did the Spacers and the bulk of the creature work, like the Bishop's Claw, the Hive Mind Lizards and the Ice Lunes. They also did some of the Terminus extension work.
- Outpost were responsible for Demerzel, the Rubicon, Maiden Moon, Surrah and some of the Vault sequences. They also were our de-aging vendor.
- Mackevision did the Deliverance slow ship work, Crypod and the Mural of Souls.
- Scanline did most of the Terminus city work, timelapses, Helicon Raven shots and some Sandograms.
- Rodeo took on the Trantor Scar, the Aegis, the Lancers and some creature work.
- Buf did some of our space exteriors, the Spiral cave, Raven shots, both exterior and interior.
- Chicken Bone did some Vault shots, Cleonic Aura effects, Holograms, some Synnax water work, Sandograms, muzzle flashes, and cleanup.
- Crafty Apes did crowd and Vault shots.
- Bot did the majority of our wire removal and paint work. They did some Terminus CG work as well.
- Spin, I can't say exactly what they did because they are major plot points but they did some work involving the Anacreons and Synnax.
- WhiskeyTree did some Terminus work for us.

Mike Enriquez // The only one Chris missed was Rocket Science, who did some interior Invictus work for us.



Where were the various exterior sequences filmed?

Chris MacLean // We were based in Ireland. We had our studios there and shot some exteriors in Adare and Dublin. Iceland and Canaries were where we shot Terminus, Malta, we shot in the tanks and locations there. Germany was shot for Trantor. The more we got in camera the more I could spend on the big VFX set pieces, so Rory and I really collaborated. We went out of our way to find locations that worked for the story and gave us the epic scope we were after without breaking the bank.

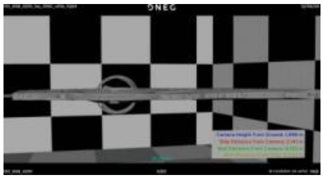
How did you work with the art department for the various locations and ships?

Chris MacLean // Rory and I were in lock step for the whole show, the Visual Canucks, like Bob and Doug Mackenzie in space. We scouted together, he would take a design as far as he could and then hand it off to me for our piece of the VFX puzzle. I put a bug in Rory's early on, I told him I needed designs for not just what we were going to shoot but for all of the VFX worlds as well. More times than not the visual effects heavy design falls on our plate after the fact but we wanted a cohesive world. I helped where I could and where I was needed, like the Prime Radiant, Sandograms and Vault, but Rory really took what I said to heart and went for it. We hired a lot of great concept artists, like Paul Chadeisson and Wayne Haag to help with the ships and fleshing out the worlds.

I think one of the coolest ship design moments was when Rory and I came up with how we were going to visualize FTL travel. We were watching a lot of Sci-Fi movies at the time and we kept going back to Interstellar for how grounded it was in reality. We had an "Aha!" moment, what if the ship generates its own singularity and folds space! I took this to Chris Keller and the team at DNEG started riffing on it. It became our perfect moment to do an homage to some of the Sci-Fi visionaries of the past but also to make something of our own.

A lot of our aesthetic for this moment, and many others in the show, was based on this premise: What if we took the grounded reality of Interstellar or Gravity and then introduced the technicolor punch of a 70's Sci-Fi cover like a Chris Foss, Michael Whelan or John Berkey. For the FTL jump we were like, ok, DNEG knows how to do singularities and black holes ala Chris Nolan and Paul Franklin. Then I got thinking of folding space and kept going back to the slit scan sequence Doug Trumbull's effects for 2001: A Space Odyssey. I thought to myself what would that look like if we did that today? We shot some high speed wire wool elements that inspired some of the streamer effects. We introduced some smoky multicolored plasma. Once we put all this together… man, it was just so fucking cool. Even better, Paul Franklin stepped in to help us out with these shots. We showed this to David Goyer and he was blown away.

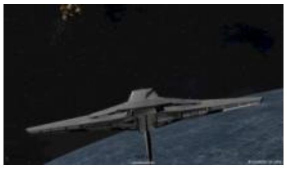
VFX took on a bit of the space work design like planet views from space but it was all based on discussions with Rory and buy off from David. Tory Miles and Jordan Nieuwland did some planet dev for us, like Anacreon, Thespis, and Maiden Moon.



Did you receive specific indications and influences for the locations and ships?

Chris MacLean // I can't speak for Rory too much but if you look at the design language of the ships they are all based on basic primitive shapes or based on a simple idea. The FTL ships are knife blades that cut through space and time. The Beggar's Lament is a galactic bush plane, like one that might deliver people and goods to Alaska. The Invictus is three concentric rings. The Imperial Shuttle is a switchblade. The Deliverance is a long haul tuning fork. The Blue Team Shuttle/Synnax Transport is an inflated microwave popcorn bag… I made that one up but you get the idea. We would start from those simple ideas and then flesh them out from there with the concept artists and design teams.

When it came to the environments we were very much influenced by what David had written and the description of the environments. Terminus was a planet low in metals and had extreme weather. Anacreon is a jungle planet. Thespis is a planet rich in metals and palladium. We would then look for locations that worked with our aesthetic and augment them to fit our needs. Rory had a design or style in mind for every world. Trantor was brutalist. Terminus was a Western frontier town. Synnax was a mix of Bolivian Boat Culture and Neolithic Germanic Engineering.



Can you elaborate about the creation of the various environments?

Chris MacLean // We spent a lot of time finding locations that worked for the story and then augmenting them instead of building the sets outright. A good example is Gaal's hotel room in the first episode. That was a floor of the ICC in Berlin. The window was there and there was that great set of cylindrical windows to the right that were in camera. Rory built the hotel room around the window and VFX scrubbed out the Berlin buildings and put Trantor out there.

For Terminus we started in Iceland based on David's description of Terminus, and then moved to the Canaries. Rory built a portion of the Foundation City there and then VFX extended it and we extended the tower. For the most part we got most of this in camera. We did a lot of in camera work there around the city as well. It kind of became our volcanic Terminus backlot. We shot a bit of Maiden Moon there as well.

Synnax was probably the most difficult VFX location. The tank in Malta faces north and you always want to shoot South to avoid squinting actors and front light so we bit the VFX bullet and decided to roto everything instead of using the one side of the tank that faced the ocean. We coined the phrase FRE: F**cking Roto Everything.

Some of the environments are really vast. How did you handle the scale challenges?

Chris MacLean // We picked our moments. One thing that we tried to do was to save the scope for when it paid off. For example, if we were in Terminus we would intro the scene with a big shot of the moons and the city and then go to medium wides and close ups. Another trick we employed was shooting anamorphic or wide open so the background fell off. Skinny focal widths are your friend when you are trying to mitigate runaway VFX shots.

The locations are seen in various lighting conditions. How does that affect your work?

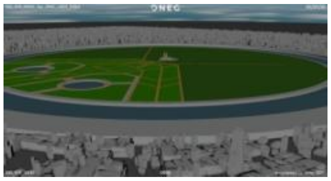
Chris MacLean // Balls and Charts and HDR captures, oh my! Because we would often be running an exterior scene at a location from sunrise to sunset, we would need to collect as much lighting info as possible. Every setup we would get a set of balls and charts, or roughly every half hour. We would also take an HDR capture every half hour to hour depending on the lighting change. These were the rules we set up with the ADs and we managed pretty well. If there was a rogue cloud during a take we would make sure we got a new data set as well. Our data wranglers were champs on this show.

Can you tell us more about how the various shaders and textures work?

Chris MacLean // In general? Shaders and textures are pretty straight forward these days. PBR engines and shader unification allows us to collect and share data between multiple vendors and they can all usually get the same results, depending on artists of course. Whether it’s Arnold, Renderman, Clarisse, V-Ray, Mantra, all of the render engines have started to standardize their shaders a lot more. I mean you still get differences like roughness vs glossiness or metalness vs reflection color and things like that but the science is relatively similar. Everyone still seems to have their own flavors of subsurface scattering though.

As for textures, a lot of custom paint work was done for things like the ships, creatures and spacers. Everyone has their favorite tools these days, Mari, Substance, Zbrush, Photoshop, etc. Not much has changed in that regard over the last five years save for 4k and HDR TVs which have put a huge strain on the amount of detail you need to put into your assets.

For the practical base textures a lot of our work off texture bombs of sets and locations. Drones were a huge tool for us on the show. We could scan large areas and get 3D data we could hand off for matte painting and tracking. For characters, digidoubles and crowds I built a 150 camera photogrammetry stage that we used to scan digidoubles and crowds.



How did you populate the streets with crowd and activity?

Chris MacLean // We shot a lot of tile plates and did a bit of digi crowd work. Due to Covid we had to limit the number of extras so there was a lot more of this kind of work than we had initially planned for.

Which location was the most complicated to create and why?

Chris MacLean // That is probably a toss up between Trantor and Synnax. Trantor, because of the sheer amount of assets that needed to be created to make the city feel believable. Synnax, because we were shooting on a tank and had to seam up water with the practical.

How did you manage the impressive destruction of the city?

Chris MacLean // DNEG was responsible for this. They were involved early on with previs. We honed in on the shots and assets that we really needed for every angle and then they worked those up to be destructible. We couldn’t afford to build the whole city so we had to be very pragmatic with our destruction and design these shots in a way that fit in our budget but didn’t suffer from lack of scope.

Can you elaborate about the creation of the various ships?

Chris MacLean // The ships were designed and then we decided which ones we wanted to build practically and which ones we wanted to do exclusively in CG. We really wanted to do them all as miniatures but time and budget wouldn’t allow for it. We also realized that given the accelerated delivery and Covid restrictions, we would have to do more digitally. The ships we did build as miniatures were 3D printed and then we lit them internally with LEDs.

We then shot them the same way you would render a shot. The vendor would deliver animation pass based on tech vis that would run the motion control camera rig and model mover. We would do a beauty pass, individual lighting pass i.e. engines, running lights, key light, back light. Then we did a utility matte pass. We got quite a bit of great footage.

We then digitized all of the practical models we built of the ships, scanned them and took texture photos. These were then given to the vendors as data sets to build the fully digital versions of the shots. Like I said, we didn't do this for all of the ships but it help keep us grounded in reality.

Some shots involved massive amounts of ships. How did you manage this aspect?

Chris MacLean // For the Anacreon and Thespin attacks in episode two we used a combination of CG and miniature elements to create the sequence.

Can you explain in detail about the beautiful "living" paintings?

Chris MacLean // Mackevision devved this for us and it turned out beautifully. David had written Mural of Souls as "active chroma." Rory and I pondered this for a bit. We started doing camera tests with acrylic in and ferro fluid. We mixed multiple colors together with magnetic oil and ran magnets under the basin. It looked great but we needed more texture. We both landed on the scene in Samsara as reference, where the monks are making a mandala out of colored sand and we were like, "what if the sand was magnetic? What if you stared at it long enough it started to move, like an acid or mushroom trip?" It also kind of lived with the same visual vocabulary as the Sandograms we were using for our Empirical holos. We sent the brief to Mackevision and they sent us back three test shots. David, Apple, Skydance, everyone fell in love with it. We had to pick our moments with it but it is most definitely one of my favorite effects.

Which sequence or shot was the most challenging?

Chris MacLean // Two sequences come to mind but I can only talk about one of them: The Trantor destruction sequence was definitely the most technically and budgetary challenging. We had to find a way to tell this story but keep it about the people who it was affecting. We had all these big grand VFX shots planned in previs and then needed to interweave the human element into it. We also realized early on that the elevator stalk was much too short in our initial designs so there were some pretty drastic blocking changes early in the sequence. That being said, it is one of the most satisfying to watch.

Did you want to reveal to us any other invisible effects?

Chris MacLean // Invisible effects aren't really part of the brief on this show;)

We did some de-aging on Mari and Abbas in 102 and 103.

Is there something specific that gives you some really short nights?

Chris MacLean // Early on I had a few nights where imposter syndrome kicked in a bit. Once I got in the groove with Rory though, it all became evident there was a path to making something we could all be proud of. Then when Covid hit, there were a few sleepless nights where we got to a point where we were dealing with so many vendors and so many issues related to schedule that I thought we weren't going to make it. We did though and I really do have my team and the vendors to thank for that.

What is your favorite shot or sequence?

Chris MacLean // Visually, definitely Gaal leaving Synnax and her ride to Trantor in episode one. There is another scene with similar scope I love as well but can't talk about yet!

What is your best memory on this show?

Chris MacLean // Getting to work with some of the most talented people I've ever met. David, Rory and Michael. I've already written a novel. There are just too many to name, the cast, the Directors, the DPs, the cast, the crew, all top notch people. Also, with Covid I was very fortunate to have my wife, Stephanie, traveling with me the whole time. It was nice to have that kind of support and encouragement through all this craziness.

How long have you worked on this show?
Chris MacLean // I started on the show in March of 2019.
Mike Enriquez // I started in August of 2020.
What's the VFX shots count?
Chris MacLean // Exact count is pending but we are somewhere up around 3900 shots.
What is your next project?
Chris MacLean // Who knows where the galaxy will take me next.
A big thanks for your time.

WANT TO KNOW MORE?
BUF: Dedicated page about Foundation on BUF website.
DNEG: Dedicated page about Foundation on DNEG website.
Outpost VFX: Dedicated page about Foundation on Outpost VFX website.
Apple TV+: You can watch Foundation on Apple TV+ now.

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2. Apple TV+ shoots for the stars with Foundation and cineSync - ftrack - DNEG | 2021-10-06

In Isaac Asimov's Foundation, the future is not an unknown waiting to happen, but something *calculable, inevitable, and terrifying*.

Foundation's premise is rooted in the theory of psychohistory. Developed by mathematician Hari Seldon, psychohistory comprises a highly secretive statistical formula capable of predicting civilization's future with an extraordinary degree of accuracy. The problem in *Foundation* is that the formula has foretold, with no room for error, the imminent demise of the Galactic Empire and a subsequent dark age lasting 30,000 years. It's a prediction the Empire does not take too kindly to hearing, and one that kicks of a series of events whose ripples extend into the coming millennia.

Asimov's introduction to *Foundation* was first published as a series of short stories, commencing in 1942. These initial stories, and their subsequent generation-jumping follow-ups, were long deemed unfilmable in their scale and scope. Only in 2021 did Apple TV+ take the plunge with a new high-budget, prestige sci-fi series from co-creator, executive producer, and showrunner David S. Goyer. Over 80 episodes and eight seasons, Apple TV+ plans to finally turn Asimov's sci-fi novels into a stunning space-spanning experience that honors the original books while treading new ground all of its own.

No less than 22 visual effects companies signed on to help create the universe that, before now, existed only in Asimov and his readers' collective imagination. Supervised by Chris MacLean and Michel Enriquez, these vendors will take what was once considered unfilmable and turn it into a rich new world for audiences to explore. Below, we speak with three of these vendors—DNEG, Rodeo FX, and Important Looking Pirates—about the first few episodes of Apple TV+'s ambitious new series and how cineSync helped unite the show's spectacular visual direction.

Creating a Foundation for success

As with many projects in production in 2020, *Foundation* was hit by the coronavirus pandemic right when shots needed to come together: lockdown necessitated the entirety of post-production to be completed by artists creating from home. cineSync assisted with the transition as artists remotely collaborated and communicated on shot iteration.

"We used cineSync to stay connected, which is so widespread and widely supported that it is the standard for media review," states Chris Keller, VFX Supervisor at DNEG. Chris and his team used cineSync in the construction of Trantor, for example, which serves as the homeworld *Foundation*'s Galactic Empire. Below Trantor's planetary surface sprawl are some fifty layered cities, one stacked on top of another.

"To create Trantor, we used a tool in Houdini to create procedural buildings based on certain rules and boundary boxes that we fed it, enabling us to achieve the city on such an incredible scale," Chris explains. "We created all of these interstitial elements between buildings like bridges, platforms, and megastructures spanning thousands of meters from one level of Trantor to the next. You can also see hyperloop trains and flying vehicles, and if you look closely, you can see that the way the crowds move through this vast space isn't random. We based the whole cityscape on real city planning, a lot of research into futurism, and thinking about the history of Trantor."

Hitting a glass ceiling

Another feature regularly discussed in cineSync sessions was the Sky Ceiling. “Each mega-floor of Trantor has an artificial sky called the ‘Sky Ceiling’ comprised of circular LED panels,” says Giovanni Casadei, DFX Supervisor at DNEG. “Designing the Sky Ceiling was a challenge: you had all these different skies to think about, and sometimes you would see the ‘sky’ of one level from trenches on the floor above it. We had to sell the idea of these skyscrapers/supports going through each ‘sky’ on their way to the next floor. There was a lot to think about. We had to dial in a fine balance between making the Sky Ceiling photoreal while making it descriptive for the audience. Designing that for the client was incredibly fun.”

One significant story point in *Foundation* sees Anacreon and Thespi terrorists destroy Trantor’s Starbridge—a 40,000km tether-like space elevator that comes crashing down onto Trantor, resulting in colossal damage. Steven Moor, CG Supervisor at DNEG, worked on the sequence: “My favorite shot is when the tether falls through Trantor’s layers,” he says. “What made this shot challenging is that each layer of Trantor can have a different time of day, atmosphere, and weather. The Sky Bridge destruction shot scene takes place during nighttime, but it’s daytime in the upper layer, so effects caches emit a lot of the light. You can see light pouring through the upper layer and parts of the Sky Ceiling flickering and switching on and off. We were tracing all of this destructive geometry and the volumes. It made for an amazing image.”

The Trantor scar

The destruction of Trantor leaves an ugly disfigurement scored into the planet’s surface, known affectionately as the Trantor Scar. Initially, the Trantor Scar was intended as a miniature, but the need for on-the-fly art direction led the effect to become entirely CG, courtesy of Rodeo FX.

Arnaud Brisebois, VFX Supervisor at Rodeo FX, and his team looked at earthquake-damaged buildings for reference. “I wanted to reference where buildings had collapsed under their own weight,” says Arnaud. “Damage like that worked well to convey the idea of the tether having crashed down onto buildings and ripping them open with a strong vertical pull.

“For the mega-floor destruction, I gathered a catalog of collapsed bridges. I also looked at large explosions and the smoke plumes produced by burning chemicals, which I provided to the FX team as a reference. I also referenced building fires and deconstructed the various stages of burn damage they displayed for the surface-damaged structures.

“I reviewed these shots with VFX Supervisor Mike Enriquez in cineSync, which is a proven tool and always works well,” continues Arnaud. “Although the brief was precise in the basic requirements for each shot, there’d be a lot of room to propose ideas. For example, we would run through shots of the scar, Mike would describe what was needed from the story/editorial and design standpoints, then off we’d go to create the effect. It’s great, not to mention quite unusual, for such a large-scale project to present an open opportunity to participate in the creative process and make proposals feel welcome and appreciated. Being able to do so on *Foundation* made for a special project.”

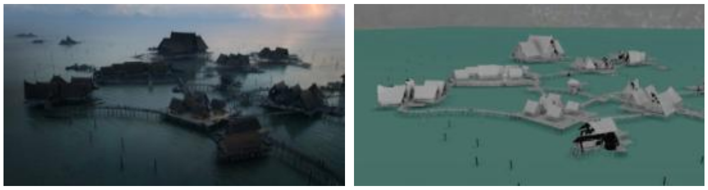
"We used cineSync to stay connected, which is so widespread and widely supported that it is the standard."
Chris Keller (DNEG)

Synnax synergy

Hari Seldon's psychohistory theory is impenetrable to most, but not to Gaal Dornick—a mathematical prodigy who leaves her homeworld of Synnax to study under Seldon as his protégé. Synnax is a water planet, where houses are built directly over a vast and beautiful sea—all of which was handled by the Swedish visual effect studio, Important Looking Pirates.

"We designed the whole Synnax village and extended the practical build, as well as doing some full-CG shots," explains Nicolas Hernandez, VFX Supervisor at ILP. "We wanted to have a lot of control in compositing, so all of the Synnax set extensions were rendered as 3D layers."

"We created the starfield above in 3D using Nuke, which allowed us to control the stars' frequency, intensity, and position," continues Nicolas. "The atmospherics were created in 3D, too: we rendered each cloud as a volume and scattered them in a controllable way to 'cloudscape' the sky. We also created a 3D nebula so we could control its look and shape and ensure we lit it appropriately for the ambience of the shot."



Creating Synnax's vast ocean surface—and the creatures that reside below it—also required input from the ILP team. "For the ocean surface, we created a lot of procedural noise and used geometric specifics—like the curvature of the peak of the wave as maps—to achieve subtle details. We also added realism to shots via neat visual tricks. For example, wherever a large object occluded the wind, we'd add fewer ripples on the water.

"As for the Sea Siren—the fully CG aquatic creature that rises to the ocean surface to interact with Gaal—we were inspired by stingrays and deep-sea fish, but with even more otherworldliness," says Hernandez. "There's a lot of detail to the Sea Siren. For example, the creature is translucent in some areas, and we painted iridescent spots on it that react to the light."

Again, cineSync played a crucial role in dialing in the desired visual aesthetic at ILP. "We used cineSync when we received the first turnover to ensure we understood the creative brief and could draw out the overall picture together," remarks Nicholas "cineSync enables us to have a synchronized vision as we discuss and iterate on shots."

An 80-year wait

Isaac Asimov first started building out *Foundation*'s world in 1942, and over seven novels, he built out a rich and extensive sci-fi world of enormous scope. It's taken television 80 years to catch up with Asimov's far-reaching imagination, and what we've seen so far still only scratches the surface of the author's operatic vision. But there's still so much to come.

We can't wait to see where Apple TV+'s series takes the *Foundation* story next. We keenly look forward to seeing visual effects by DNEG, Rodeo FX, ILP, and more shape the narrative as we follow Seldon's psychohistorical prophecy through time and space.

3. How the visual effects team kept things grounded - befores & afters | 2021-10-11

"We can't just have all of our actors working in front of a bluescreen. They need to be on a hill, interacting with the environment, the wind's got to be blowing…"

Foundation—the Apple TV+ show based on the Foundation series of stories by Isaac Asimov—is set on multiple alien worlds, features futuristic-like technologies and involves space travel. But its makers, led by creator David S. Goyer, were determined to base the show in reality as much as possible.

That philosophy applied, also, to the show's visual effects. Production filmed where it could at real locations, many of them on the Canary Islands, or on large built sets. Bluescreens and greenscreens were kept to a minimum. Miniatures were also used. That does not mean there was not significant digital visual effects work—there was—but as overall visual effects supervisor Chris MacLean related to *befores & afters*, each VFX requirement on Foundation was tackled with the grounding in mind.

Here, MacLean outlines the key visual effects challenges handled on the first three episodes.

b&a: From an overall point of view, was there a particular direction from David Goyer you were given, in terms of the visual effects?

Chris MacLean: David spent most of his time on the script and visualizing everything in the script. So we had a lot of great explanations in what was written. David's biggest concern was that the VFX look believable. When it came to the visuals, he had opinions, but it was really up to production designer Rory Cheyne and I to come up with everything and go, 'Okay, how do we do this show without making it look like another Star Trek, or another Star Wars?'

What we ended up doing is taking reality and mixing it with 70s sci-fi cover art, basically—all the old novel covers and just amp'ing up the saturation a little bit and trying to take NASA footage and mix it with that. That was the mantra we came up with.

b&a: My reaction to the VFX of the show is that everything just feels very grounded. Whether it was shooting on real locations, or some other thing like on built sets. There's clearly a lot of digital work in the show, but tell me about that grounding of the VFX?

Chris MacLean: Rory and I—we have a very good relationship—and early on we decided, 'Okay, the only way this show is going to work is if we work together to figure out how to merge the two worlds.' Often, these two areas (production design and VFX) don't talk very well or they don't get along because they think they're doing each other's jobs and it becomes a bit of a juggling act that way. But we were in lockstep the whole way. We have our moments, but we also spent a lot of time just drawing stuff, sending it back and forth, seeing what the other person thought— 'Is it going to work for you? Is it going to work for me?'

What ended up happening was–well, everybody is saying Foundation looks super expensive–and that's not the case. There are shows that have way more budget than we did, just way more resources than we did. We had to work within our box, and what ended up happening was, we realized that we wanted to spend the money on visual effects that were going to make a statement or make an impact as opposed to, 'Oh, we have to extend that set 500 times. That's going to blow our budget for the episode.' So, Rory built the sets and we figured out a way to do it so that we could save our budget for space shots and ships and 'sandagrams' [more on these, below].

The other thing that happened was in relation to the lenses that we picked. I got a little bit involved with the camera department as well, and we went back and forth on those. We did some anamorphic work with the T-Series Panavision lenses in episode one. And then in episode two, we went to some super clean Zeiss lenses on the ARRI ALEXA LF, and we ended up landing on the LF body with Atlas Orion anamorphic lenses. What happened was the anamorphic lenses actually helped us out a lot—they had such a shallow focal width that everything falls off. With those lenses, we could have that de-focused look. So, especially when we were shooting outdoors, a lot of the time there would be some bogies like some towers or a house or something in the shot, but with those lenses it would just fall off to nothing which meant we didn't have to do a paint-out shot. Everything we did was to mitigate extraneous visual effects shots so that we could build a whole water planet, say, and then spend our money there. It all came out of necessity because we didn't have the budget to do 6,000 visual effects shots on the show.

b&a: Even on Terminus—an alien other-worldly planet—it feels like you could use real exotic-looking locations.

Chris MacLean: It's a mix of Iceland and Canary Islands. We had to move from Iceland because where we had originally put Terminus, there was something that wasn't safe there, so we had to leave. The U.S in the 90s used to go shoot tanks in Iceland and we found some unexploded ordnance. So we had to find a new place. We landed on the Canaries because it had a little more temperate weather. We were shooting in November in Iceland as well which was probably not the best time to be shooting in Iceland. It was very windy. We had sets blowing off the tops of mountains. It was really fun, but we needed to find a place where we would know that our sets and crew would be safe.

Roy built a portion of the town for Terminus in Fuerteventura, one of the Canary Islands. And then we also moved the Vault, there was another space that we found on the Canaries that looked identical to where we had done the Vault in Iceland. We spent a lot of time with our iPads out saying, 'Okay, that kind of looks like the same hill.' Still, it was a big fight to shoot somewhere for the Vault. Everybody would say, 'Just do it in visual effects.' But we would say, 'No, we don't want to do this all as visual effects. We can't just have all of our actors working in front of a bluescreen for the Vault. They need to be on a hill, interacting with the environment. The wind's got to be blowing…', all that stuff.

b&a: Just to continue that sort of grounded feel, I was really excited when I saw in the credits Ian Hunter's name, for miniatures. What were the miniatures in the first three eps?

Chris MacLean: I really wanted to do some miniatures on the show, even if it was just for reference. In fact, a lot of times we shot something and ended up going fully CG anyway, but we would give the plates to the vendors as reference. We brought Ian on and we built the miniatures to ground us again in reality. You know, one thing I hate more than anything is when a camera doesn't feel real. Where you get a CG camera and it's doing 360s, moving a million miles a minute. There's no weight to it and all that sort of thing.

So, our idea behind that was, we would have the ship, we would have the motion control rig, we would have the camera, and we take that option to move the camera in a crazy way away. It means you are locked into this world where you have to figure out the moves in a realistic way. What we found was that we could move a lot slower and it would feel more real.

The miniature builds came from Odyssey Studios in Limerick, Ireland. Mark Maher there used to be a miniatures guy at Weta Workshop. Ian Hunter supervised the whole build process for that, he'd go in and make sure that the paint aspects were working, and everything else.

b&a: To continue that grounded discussion, I even felt that also existed with the holograms, the volumetric ones. They're things that might normally be really 'sci-fi' but there was something more physical about them.

Chris MacLean: Well, with the holograms on the show, I was, for a while, very perplexed on how to do them in a different way. How do we do holograms so that it's not just, 'Oh, look, a hologram'. So, I talked to the guys at Tendril and said, 'I want a particle-based hologram, where the emission source or the emission type is particles, and they actually cast shadows and receive light.' The tech is, it's pulling dust particles out of the air, or small atoms, and organizing them in a way that they're creating an image.

They started with the prime radiant math, and then we did some busts. You kind of see that technology again when we get into the Hall of Cleons and Dusk is walking past looking at the busts as they form. We called them Sandograms.

We did a few versions where we did some volumetric captures, while some of them were two-and-a-half-D. It is a lot of work to process video-based volumetric scans of people and then put them into a simulation and light them and render them, so DNEG came up with a solution for that which we used quite a few times.

b&a: I also thought the moving pigments in the mural scenes were beautiful—maybe even for my Apple TV screensaver?

Chris MacLean: That was Mackevision. We had this giant painting for the Mural of Souls that we actually had built. David had written, 'active chroma', in episode one. And we were like, 'What is that? What is that?' We tried playing with acrylic inks and ferrofluid and we started shooting that practically. With my 24 mm probe lens we were scraping it through the ink, running a magnet underneath it with the ferrofluid moving all the ink. It was really cool but it looked too wet.

I sent Rory some reference from Samsara of the monks doing the mandala and then brushing it away. We said, 'Okay, let's lean into this a little bit.' Then to Mackevision we said, 'Now we need to do this based off of grains, and it kind of lives in the same world as the sandograms.' We wanted the painting to 'move', where if you stared at it long enough you could see the pigments shifting.

And we actually redid the mural practically, after we got the VFX shots back from Mackevision. Rory hadn't originally crafted it with a sand texture in mind, so it wasn't as rough as it needed to be. We went back and

re-vinyled it with this sand texture, and we had time to do it because COVID hit. It gave us a little bit more time to fix a few things.

b&a: When Gaal travels to Trantor from Synnax, there's an amazing shot where the ship goes into warp speed and looks like a black hole. How did that come about?

Chris MacLean: That came from a mix of what Asimov wrote about travel, and then us wanting to riff on an ode to sci-fi. Overall it came from David Goyer's description of the FTL ships as knife blades cutting through space. We then thought, let's have the ships generate their own singularity and cut through space.

So, the black hole, obviously that's inspired by Christopher Nolan and what Paul Franklin, at DNEG, had done on Interstellar. There they came up with the black hole simulator. And luckily those shots were sitting at DNEG, so we were like, 'Hey guys, what can we do here…?'

The other inspiration was Doug Trumbull's slit-scan sequence from 2001: A Space Odyssey. And then all of the cover art by Chris Foss, Michael Whelan and John Berkey. We were like, 'Okay, now we've got all the ingredients for the recipe, how do we make the cake?' I started painting what this slit-scan horizon should look like. We sent it back to DNEG and came back a few times and we just kept riffing on it. Paul Franklin actually got involved for those shots because we were having a little bit of trouble with blocking. It was just really great to be able to build that up and make it and see what we had originally set out to do come to life.

b&a: What about the Starbridge, and its destruction?

Chris MacLean: We started off early on with Rupert Sanders and David Goyer previs'ing that sequence with Chris Keller and the previs team at DNEG London. We previs'd it all, we set it to music, we did the whole thing and it was like, 'Wow, this is pretty cool.' And then what happened was, we were framing everything to some of the concept art that was done. We'd shortened the stalk on the Starbridge and it wasn't working with the scale of what we wanted to do.

So we just decided to go for it and make it as long as what it is explained as in the script. It meant we got this giant perspective and sense of vertigo from the Starbridge to the planet, where the planet looks so tiny. It just really, really started to work as soon as we moved the Starbridge away from the planet.

Concept designer Paul Chadeisson did the concepts of the Starbridge with Rory, and we wanted it to feel like tech that had evolved from humanity, even though it's 25,000 years in the future. We decided we wanted the bronze plating on the Starbridge, similar to satellite solar panels today. The way that we did the stalk was very interesting. We just said, 'Let's make it a vertebrae.' So it's jointed, it's built up in sections. Which means that when it falls, we've got all of this bending and torquing, and it worked out really well. Doing the stalk in sections also gave it a great sense of scale.

For the elevator cars, we built a set for this and we ran an LED screen outside of that when we shot it for interactive lighting, which was done by DNEG. We ended up replacing the background, though, because LED screens are great for lighting and reflections, but that's about it. Well, they're good for out of focus backgrounds, because you can't focus on the screens yet. Nobody's come up with a diffuser to put in front of them that makes them work on camera.

We animated a loop that we would play for the actors, and there were stunts involved and had everybody freaking out. When Lou Llobell as Gaal walked up and saw it for the first time, she was pretty amazed that we had done this and she thought she would have to stare at a bluescreen the whole time. It was good for the actors, it was good for us, because we had something to ground us.

Interestingly, because people don't pull keys anymore, they just send their shots out to get roto done, we didn't use a lot of bluescreens and greenscreens on the show. We picked our moments for that. If there was an opportunity to avoid spill we went for white or blacks.

b&a: I was going to ask you whether you had time and budget and inclination to use any virtual production approaches for the show. As you say, they can be useful, but they're also not always the definitive answer.

Chris MacLean: We picked our moments for using the LEDs as well. In the natatorium, the swimming pool on the Deliverance, we had the star field outside and an asteroid field on a screen. We had them fly by a nebula which we played outside for lighting. It was great because it gave us a reflection in the water, it gave us all these things that we maybe wouldn't have thought about if we had just done it with a bluescreen.

We also had an LED translite outside of the palace window. You see that when they're eating in the dining room. That's Trantor outside on an LED screen. And then the elevator when Gaal's riding down, we had the screen there that I mentioned earlier. We had screens outside the FTL windows for the travel sequence. However, none of it was real-time rendering, say with Unreal. It was all pre-rendered. It was all just playback, basically.

At one point, when Gaal leaves Synnax, they wanted some interactive light on her, so I had an LED TV in my office that I wheeled out and put beside one of the windows and played content on to get the reflections and lighting on Gaal's face. It's when she's crying, when she's leaving Synnax. I played some clouds going by and it worked. The cinematographers and the lighting department started bringing in rock n' roll LED panels to do interactive lighting for some of the sequences. Again, it just helped with grounding everything.

b&a: One shot I wanted to ask you about was on Terminus where we see the timelapse after their arrival. How did you achieve that one?

Chris MacLean: Well, David wanted time to be a character on the show. In the first three episodes there's a lot of time jumps. The time lapses came from that idea. Scanline worked on this. I actually had a slider and some extra cameras that we set up around Terminus, and we shot real time lapse footage. While everybody else was shooting, we would shoot all this reference, and we gave that to Scanline and it was all based off of those angles and that reference that we gave them.

We even set up a time lapse camera, a solar time lapse camera, when they started building Terminus. We had that go until Terminus was finished being built—it was probably two months of footage. That was good reference, but I don't know if it ever made it to Scanline. Then it involved building assets and Scanline using a scan of the area we gave them. They blocked it out, then they sent us some lighting samples because we wanted to know how many times the sun was going to go around the planet, when the moon's going to fly by, what was going to happen in the sky, all of that sort of thing. Once we got that locked in, we knew we had a sequence that worked.

b&a: The last thing I want to ask you about is the Vault on Terminus. There's some interesting issues there with color, absorption of light, scale. These are things I feel like you had to solve as well as being concept and design issues.

Chris MacLean: With the Vault, we had almost a little bit of a contest between Rupert Sanders and his design team and Rory and us. It was a tough thing to nail down. Some people wanted to do an asymmetrical, brutalist thing floating in the air, and some people wanted it just to be a cube or a sphere. At one point I did a super simple drawing, a cut up shape with two diamonds.

We all sent in these designs to Matt Cherniss at Apple. I had sent that simple drawing to DNEG. They did some concepts, we sent them to Matt and he was like, 'Yeah, this is great. This fits in with the story.' We all knew, of course, what it was going to become later on, and I won't give anything away. There's a method to the madness in terms of how we designed it and why we designed it that way.

b&a: Well, I cannot wait to watch the rest of the show, thanks so much for talking to me about it.

Chris MacLean: I had a huge team helping me—Mike Enriquez, Addie Manis, Kathy Chasen-Hay from Skydance—they were all huge, huge helps to getting this thing done. There were a lot of people who came on and really, really helped us to get across the finish line.

4. The VFX secrets of Apple's epic sci-fi series - DNGE | Creative Bloq | 2021-10-19

By Trevor Hogg (3D World) published October 19, 2021

Discover how Foundation was brought to the screen with the help of stunning visual effects.

Foundation is Apple TV+'s adaption of the seminal sci-fi book series by Isaac Asimov. The premise is ambitious, to say the least, and tells the story of a mathematician who develops an algorithm that can forecast future events, putting him into direct conflict with a galactic empire when he predicts its demise. Asimov's epic literary vision has been adapted by co-creators David Goyer and Josh Friedman, Skydance Television and Apple.

For this behind the scenes look at Foundations visual effects, we spoke to Goyer and some of the talented VFX artists that worked on the show to find out how they built new worlds, visualised interstellar travel, rendered new technology and much more. When you're finished reading this feature, find out all about the design of Foundation in our interview with acclaimed concept artist Stephan Martinière. But for now, let's find out how cutting edge VFX helped make Foundation's more otherworldly elements a reality.

Laying the visual foundations

ILP used 3D elements for the clouds, nebula and starfield that appear in the sky of the planet Synnax (Image credit: Apple TV+)

The main visual references for studio executives on Foundation were Star Wars, Star Trek and Alien. "We told them, 'It's not going to be like any of those things'," recalls Goyer, who serves as an executive producer, showrunner and writer. "But if you don't have anything to point to at the beginning it becomes daunting to develop the visual language. We kept coming back to 'What's something we haven't seen before? What's something that is iconic? What's a shape that feels simple?'"

Considering the vast scope of the production, which takes place on various planets over thousands of years and involves space travel, VFX were a critical part of the storytelling. "What I tried to do in the script is to at least emotionally describe the effect, because I always come from a place of story. The Empire is aggressive and male so I wanted their ships to be like knives, which meant that they weren't just folding space but ripping it."

Shooting the stars

Empire ships fire upon the planet of Anacreon (Image credit: Apple TV+)

An additional 19 VFX vendors had to be brought in to support lead vendor DNEG, Important Looking Pirates and Outpost VFX as the VFX shots for the ten episodes of Season 1 went from 1,500 to 3,900. "I realised early on that we needed a second visual effects supervisor because there was such an overlap between physical production and post-production, and the different time zones," explains Kathy Chasen-Hay, senior VP VFX, Skydance. "Chris MacLean couldn't be available while he was supervising on set and was a large component on the creative side in physical production. Michael Enriquez came in and carried the post and burden of vendor communication. There were lots of Sophie's Choices made by David Goyer because you have to hit a number and fit it in the box."

However, even with the travel restrictions caused by the coronavirus pandemic, Goyer was not prepared to compromise principal photography taking place at Troy Studios in Ireland, Germany, Iceland, Malta, Fuerteventura and Tenerife. "I started by saying, 'We are going to shoot 20 per cent of the show on location.' But secretly my goal was to shoot 60 per cent which is what we ended up doing. I wanted each country to represent a different world and for the actors to feel cold."

"The visual effects had to be as naturalistic and photoreal as possible. I want the show to feel like a Terrence Malick movie and for the actors to experience as much as they can in reality. The amazing thing is when we started up again, we never shut down once because our protocols were so rigorous. We went back to nearly five months of location shooting and chartered planes to fly the crew because we didn't want to expose them to the airports."

Assembling the sets

A massive environment build for DNEG was Trantor, which is the heart of the Empire (Image credit: Apple TV+)

Each set was designed in three dimensions under the direction of production designer Rory Cheyne. "We then had to reverse engineer those models to turn them into something which was buildable by guys in a workshop," states Conor Dennison, who was a supervising art director along with William Cheng and Adorjan Portik. "We set up Unreal Engine and a whole VR department within the art department. We would literally give David Goyer, the directors, producers and executives from Apple a set of VR goggles and say, 'Off you go. Walk around the set. See what you think.' It was fully lit and textured." Rhinoceros 3D became the design software of choice. "The learning curve was stiffer but what you could do with the models afterwards was phenomenal."

An 'Aircar' was physically constructed. "We got a dune buggy from Germany and brought it back to Limerick. We cut it down the middle, stretched the whole thing out for an extra 10 to 15 feet, put in a new roll cage, new hydraulics, and built an Aircar sitting on top of it. One driver was facing forward and the other facing backwards underneath looking at the actor overhead. When they were going to the left the pneumatics were set up in such a way that it would go to the right, so the actor would go the right way."

Otherworldly devices

Hari Seldon is shown with the device known as the Prime Radiant (Image credit: Apple TV+)

The device known as the Prime Radiant displays the lifework of revolutionary mathematician Hari Seldon (Jared Harris). "What I kept saying to Chris and the team was, 'We know that Hari Seldon and Gaal Dornick [Lou Llobell] are the only people that can understand this math, but we're so far into the future I don't want to see Arabic numbers," remarks Goyer. "I also want it to be beautiful and spiritual. When Gaal and Hari look at the math it's almost like they are communicating with angels or God." The solution was found at the Toronto-based design house Tendril. "We went to Chris Bahry who in his spare time does quantum math," states Chris MacLean, production VFX supervisor. "He came up with something that I hope becomes the ultimate sci-fi MacGuffin."

Holograms in Foundation take the form of 'Sandograms'. "The majority of our holograms are meant to be solid particles that coalesce into whatever the hologram was," notes MacLean. "It worked extremely well with static objects and a 2.5D approach that Mike developed with DNEG." Michael Enriquez, production VFX supervisor, adds, "I liked the concept of it not emitting light and being a physical object in the scene. The technology is so advanced that you don't need an explanation for why it works."

Creating the mysterious artefact

The most difficult design challenge was the mysterious Vault, which was created by DNEG and shared with multiple vendors (Image credit: Apple TV+)

Prominent on the surface of the planet Terminus is a mysterious artefact that has a presence similar to that of the black monolith in 2001: A Space Odyssey. "Rory and I were like, 'It has to be like Arrival'," states MacLean. "It has to be this simple thing. I started to get into divine geometry and drew a simple diamond with a bit of a facet on it and mirrored it. I sent it to DNEG and they sent it back to us as a concept with this glowing centre. Rupert Sanders, the pilot director, got his designer Ash Thorp to do the same kind of thing. We sent it to Matt Cherniss at Apple to decide and he liked the diamond shape."

Even though the final design was decided in post-production, a partial practical element was constructed for principal photography. "We built the bottom six feet which was a little wedge shape with a light feature coming out of it; that was hanging off of a crane up in Iceland on the top of a mountain," reveals Dennison. "Visual effects needed to have the effect of light for when Salvor Hardin [Leah Harvey] got up close to the Vault. The light naturally lit her up. Everything else was visual effects afterwards."

Depicting space travel

DNEG was the lead vendor, responsible for 1,188 shots including the singularity effect used for space travel

When it came to visualising faster than light space travel, DNEG had to be cinematic while maintaining a sense of scientific authenticity. "We wanted to create something that had all of the natural phenomenon that people would recognise," states Chris Keller, VFX supervisor, DNEG. "The logic behind the FTL ship and the Invictus later is that they create an extremely high energy field in the centre that collapses into a singularity. It's like a mini black hole that folds space time into this trippy looking smoke trail. We made it a dreamy, almost psychological effect. Whenever the spaceships appear we're already at the destination and this bubble opens up and the ship pops out. The ship drags along with it some of that smoke and spark elements which we did using wire wool."

Many different simulations were required to produce the singularity effect. "You have particles and fluid simulations interacting with each other and evolving into something else," remarks Giovanni Casadei, DFX supervisor, DNEG. "Our main challenge was to define the different components and make it look like a cohesive effect. We had subdivided effects and with a lot of help from compositing we tied them together."

Using volumetrics in space is effective but not easy to achieve cinematically. "Sometimes we would do wedge tests where we would take a diorama scene with all of the different objects, and we would take a light and spin it around until we found the most pleasing angle," notes Steven Moor, CG supervisor, DNEG. "You have to put a suggestion of a lens flare on the edge of the frame and that's how you can sell the idea that the shot is backlit by the sun out of frame."

World building

Lee Pace portrays Brother Day who is part of the clone dynasty of Emperor Cleon I and ruler of the Empire

Displaying the history of the Empire in the Imperial Palace is the Mural of Souls, which is made of moving colour pigments. "We tried an interesting approach which was putting a bunch of acrylic ink in a pan, using Ferrofluid and running a magnet underneath it; that was filmed at a high speed which gave us a cool look, but it would have been impractical to have the mural wet all of the time," notes MacLean.

"Then we came up with the samsara where the Tibetan monks make mandala out of sand and wipe it away. We said, 'What if we take that and turn it up to 11. Take the magnets from the Ferrofluid and have the sand be magnetic.' The magnetic sand stays on the wall, twirls and makes these crazy images."

Simulations were placed on top of the physical mural created by the art department. "There was depth given to the various key features on the mural so depending on what was actually there, there was a custom particle layout, motion paths and noise fields," explains Enriquez. "It was a lot of back-and-forth testing, and once we got it to work, the effect went throughout the entire shot. Kudos to Mackevision for getting that going."

This article was originally published in 3D World, the world's best-selling magazine for CG artists. Subscribe to 3D World.

5. Foundational Visual Effects - Chris Keller (DNEG) | fxguide |2021-11-15

Foundation on Apple TV+ is a complex saga of humans scattered on planets throughout the galaxy all living under the rule of the Galactic Empire. The show started with psycho-historian, Dr. Hari Seldon (Jared Harris) and his loyal followers who attempt to preserve their culture as the galaxy collapses around them. The TV series based on the landmark books by Isaac Asimov. was brought to the screen by David S. Goyer. Apparently, Goyer pitched the series in one sentence: “It’s a 1,000-year chess game between Hari Seldon and the Empire, and all the characters in between are the pawns, but some of the pawns over the course of this saga end up becoming kings and queens." DNEG was the primary VFX vendor.

The episodes have great directors, including feature film director Alex Graves (*West Wing*, *Game of Thrones*), Roxann Dawson (*The Morning Show*, *The Americans*, *The Good Wife* + she played "Lt. Torres" *Star Trek: Voyager*), along with Rupert Sanders the feature film director (*Snow White and the Huntsman, Ghost in the Shell*).

The overall visual effects supervisor was Chris MacLean. Chris Keller was the VFX Sup on *Foundation* at DNEG. He worked on the film for a total of two and half years. The film visually references a vast array of films and visuals from 2001 to Intersteller. The film is a TV series but the visual effects are very much cinematic epic Sci-Fi. The story required vast CGI builds, complex compositing and a complex set of visual languages to underscore the vast number of races and cultures under Empire's control in the show.

Cast on set behind the scenes during a break in filming.

COVID hit the production right after episodes one and two had been filmed but the inevitable delays COVID caused actually helped the Production as it allowed time for an incredible amount of design exploration and visual imagery development. In total, the 10 episode series has about 3900 VFX shots, and there were 1050 final shots provided by DNEG including environments, ships, and the highly complex destruction sequences. DNEG did PreViz, PostViz, virtual production and were responsible for most of the shots of the Vault, and most of Trantor including the Imperial Palace, space elevator and its destruction, along with faster than light travel 'jump ships', including the Invictus Battleship. The team also did the Prime Radiant and the programs holograms nicknamed Sandograms.

When Sci-fi meets Hari.

Sandograms

Psychohistory is the fictional maths in the *Foundation* universe that combines history, sociology, and mathematical statistics to make general predictions about the future behavior of very large groups of people, such as the Galactic Empire. the Prime Radiant is a device designed by Hari Seldon for storing the psychohistorical equations showing the future development of humanity. To visualize this maths data for the audience, the imagery appears as a complex hologram. In the shows, visual language any hologram is achieved by some device manipulating particles that float together to show a near-solid object or image. Asimov himself said in interviews that he "modeled my concept of psychohistory on the kinetic theory of gases". A visual design element that DNEG clearly touches on with on-screen Prime Radiant. The technology does not emit light so it was a fresh take on the usual Hologram solution. It was initially designed by design company Tendril and is seen both as the visualization of the Prime Radiant and as several other towering statutes or communication interfaces.

The Sandograms were original, and "that's how everyone approached the show : let's not go to the obvious trope that's been done a million times," says Keller."Let's think about fresh ways of displaying these things, but that also makes sense within the story. How would a civilization develop these things if they just started from scratch without our preconceived (cinema) notions?" The Sandograms were designed in Houdini but executed by DNEG's motion graphics team who mainly 'work in Cinema 4d and After Effects and some Nuke – which is slightly off our normal pipeline, but they're extremely flexible, fast and creative," he adds.

			Odyssey Studios and Ian Hunter produced minitures used as reference and elements for ship shot. DNEG's final shot with complex sims and fire elements.

While the maths of the psychohistorical equations are fully fictional. Keller being “a big sci-fi geek. I just love having actual hard science in this show.” In the scene where Gaal works out with the info cube where her mystery ship is headed, all the calculations are “based on real maths and triple checked by mathematicians and scientists. We had a great time, doing this, it was actually one of my favorite sequences to work on. All you see is real and all the calculations she's doing, they all make sense, the triangulation would work if you did it,” says Keller proudly.

Trantor Brutalism

Musco Castelvecchio. Image Flickr user Andreaosti licensed under CC BY 2.0

The complexity of Trantor was its layered construction with synthetic skies and massive industrial structures. This combined with the Starbridge space elevator required a huge amount of design. DNEG did a large amount of their own concept art to explore how the multi-layered city might function. This included extensive cutaway sections and detailed concept exploration independent of any particular shot. “Everything is this show needed to feel like it had a history,” explains Keller. “Everything had to seem like it had been there for hundreds of years.” Foundation's art department decided early on was to design a Sci-fi city around the architectural style of Brutalism. Brutalist architecture emerged in the 1950s and grew out of the early modernist movement. Brutalism is characterised by massive, monolithic, and blocky forms without many windows, very much in a rigidly geometric style. “They wanted that very imposing, imperial, and yet functional look. We looked particularly at architect Carlo Scarpa, whose work is based on brutalism but with a lot of flourishes, which are needed on an Imperial Planet, – we took that style and really ran with it. All of Trantor is based on this expression of power.” Some of the reference plates and elements were shot in Germany which has a strong brutalist architecture, but Scapra is known for his work in Venetia in Italy. “It was just so much fun figuring all of Trantor,” Keller fondly recounts.

Light Jump & Virtual Production

LED screen outside the ships

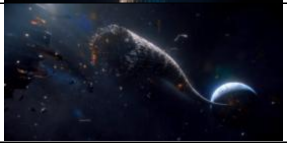
When Gaal travels to Trantor from Synnax she is played in sleep state for the faster than light jump, in what was nicknamed the ‘crash mesh’. This was a 3D organic mesh that grows around Gaal. During the jump, she wakes briefly and the audience sees not only the jump happening outside the window, but this reflected in her eye. This was all done in-camera with virtual production.

The jump ship drive forms something clearly inspired by the black hole, in Christopher Nolan's Interstellar. That film was VFX supervised by Paul Franklin, at DNEG, and he joined the *Foundation* team briefly to advise and help with the visuals of the jump ship black hole effect. In *Interstellar* the black hole was rendered with special software, and while the *Foundation* team briefly considered bringing that code out of mothballs for the series, the number of shots did not warrant it and the black hole effect was achieved in Clarisse (Isotropic). “It was so great to work with him. few people in the world are better at visual effects, – but no one is better at space than Paul,” commented Keller.

The production had large LED screens for scenes such as the Imperial Palace interior. “So before doing any kind of actual shot work, we did concept designs and created a couple of shots of the Trentor’s skyline to be put on those and used on the screens outside the Palace windows.” explains Keller. And even given their very early evolution before much of the major design work had been done, “a lot of those shots actually survived without being replaced.”

Episode 7 is a big reveal of the Invictus Battleship which might like the smaller faster than light ships seen previously referenced the teleportation machine structure from Contact. The homage is particularly effective as the Contact machine’s concentric rings with orthogonal couplings produced a wormhole allowing Dr. Ellie Arroway to travel across the galaxy. The Invictus is a planet destroyer-level Imperial ship that’s been lost for centuries. In episode seven it is counting down to do a passive space jump in Episode 8. The entire Invictus is essentially the engine seen in the much smaller Faster than Light (FTL) ships, – and its rings are able to spin and then fold space. For series creator David Goyer, “his whole mantra was always that the technology should appear to be intuitive,” explains Keller. “We never wanted to overexplain anything. It just needed to look like it belonged in the world. Like it was doing something.” For the visuals and compositing required for the FTL folding of space and especially the return to normal space-time, the VFX team used a bunch of organic elements. Fire elements, burning steel wool, and cloud elements, all provide the viewer with something visual to latch onto. “There’s always some natural phenomena that we all know that is complex right out of the gate, but familiar,” he adds.

Starbridge and falling like a giant garrote wire



In Foundation there is a massive space elevator that remains in geosynchronous orbit. But to balance the gravitational pull of the planet of Trantor, which is similar in size to earth, it needed to be vast. “The space elevator was just an incredible structure to be working on 40,000 kilometers up in space. And then the destruction sequence, which is probably one that one of the highlights in the entire series for me,” comments Keller. To put that into scale, the International space station is in orbit above the earth at only 408Km from the surface, so the Starbridge would be 100 times further away. This means the planet needs to appear quite small from the StarBridge. This is something that Paul Franklin helped work out. ” If Trantor is earth-like in size then the 40,000 km space elevator cable could actually entirely circle the planet as Earth’s circumference, measured around the equator is 40,075 km. A point made in the show when in Episode 1, Empire states that the “tether is wrapped around the plane like a garrote.”

Keller explains that “as with everything in on this show, it’s just the scale of it that was the biggest challenge, but both creatively, and technically. Destroying an entire city is obviously quite a task, so we relied pretty heavily on procedural tools.” The city had a large layer of kitbashed instancing and it was all built to be destroyed if needed. “A big challenge was the sky ceilings and making sure that the audience understands that the tether falls and cuts through multiple levels 50 layers down. That took some time figuring out!” he jokes. It was also an issue that anything that big would take a very long time to come down, which is mentioned in the episode, visually the collapse is time-compressed such that every shot tells another part of the story.

Space elevators would need to be extremely large

“The cool thing about space elevators is that they are physically feasible if you could make them… but a space elevator, like this, has never been seen on screen before, and we really wanted to embrace the fact that it floats high, high, high above the planet.” Which is why in key shots, the team had the gigantic space station, with its tether leading down to what seems like a tiny planet in the background.” When the elevator is seen separating after the explosion it would be many hours, for example, until it crashed back to the surface.

Creating the VFX 'Foundation' Epic Isaac Asimov Adaptation

Tackling what is considered an unadaptable science fiction classic from framed writer Isaac Asimov was a challenge showrunner and executive producer David Goyer (*Batman Begins*, *Man of Steel*) fully embraced, braving pandemic shutdowns and male-dominated storylines to create the wonderfully expansive, and narratively enthralling Apple TV+ sci-fi series, *Foundation*.

Creative liberties were taken in translating Asimov's epic book series, such as expanding the visuals, filling in narrative gaps, and making the story more contemporary while keeping the author's premise and themes intact. The story begins as the Galactic Empire refuses to recognize mathematical proof of its inevitable decline developed by academic Hari Seldon (Jared Harris), who is promptly exiled to the outer rim of the universe. "It's a chess match of immortality and influence," notes Goyer. "Because we didn't have anything in the beginning to point to, developing the visual language was daunting."

World building was divided between the art department, led by production designer Rory Cheyne, and FX team, led by supervisors Chris MacLean and Michael Enriquez. "Rory designed the whole show and gave us the building blocks for things that we would takeover, like the Vault [mysterious artefact on Terminus] and the Prime Radiant [device that contains Seldon's revolutionary algorithm]," states MacLean. "We tried to get as much in camera to save money for the big moments and shots. We weren't doing hundreds of set extensions, so shooting on location and trying to do things for real as much as possible helped us out immensely. Even so, there are still 4,000 shots across 10 episodes."

DNEG was lead vendor, followed by Rodeo FX, Important Looking Pirates, Scanline VFX, Chicken Bone FX, Crafty Apes, Mackevision, Rocket Science VFX, Outpost VFX, Tendril and Whiskey Tree. "One of the hardest things in visual effects is to teach somebody that there is a lens between what they rendered and what ends up on the screen," observes MacLean. "Learning that process is tough for a lot of people. Trying to teach that to everybody while we were drawing and leaning into our aesthetic was especially difficult." Like with most productions of the past two years, the workload increased because of the coronavirus pandemic. "W/ the truncated schedule, Mike came on as my post VFX supervisor to interface with vendors while I was shooting S1. He became an integral creative partner and we have continued to work together while we finished S1 and I prepped for Season 2. Our production crew roles were duplicated as well, w/ Addie Manis as VFX producer, stationed with post in LA, and Victoria Keeling as the onset VFX producer during the shoot in Europe."

One of the series' most notable changes is the introduction of women into the storyline, in particular with the pivotal roles of Gaal Dornick (Lou Llobell) and Salvor Hardin (Leah Harvey). "In terms of gender-swapping characters," explains Goyer, "there are no female characters in Asimov's first book. 52% of the world is female, so it felt dishonest to not be more inclusive. The entire science-fiction field was *very* male-centric in the 40s and 50s. Female characters were largely relegated to damsels-in-distress on book covers. And while there were a *few* female science-fiction writers working in the field, there were not many. And quite a few of those wrote under male pseudonyms."

MacLean agreed w/ alterations. "David's script unpacked the story because Isaac Asimov liked to write about the conversations that people had and skip over the action bits and what actually happened."

Virtual production was utilized sparingly on the production. "People are jumping on this stuff as if it's the new hot tech," notes MacLean. "Virtual production is great for lighting, reflections, and being a translight that you can swap out the content on. But in terms of having to track it to one camera, like they did on *The Mandalorian,* virtual production slows down the shooting process and you're locked to the shooting method of the volume."

"But," he continues, "on the travel down [the tether connecting Trantor Station to Trantor], DNEG gave us some content which we played back. The actors knew what was coming. The Unreal Engine pipeline came in handy for the elevator fall where we could loop the footage or outside the windows of the FTL ship which Gaal Dornick takes from Synnax to Trantor. We had the psychedelic slit-scan footage playing out that window while they were travelling, as well as when we filmed all the space shots. There is a scene in 102 where Raych Seldon & Gaal are in a VR room watching a sunset; that was completely shot footage which we actually rewound in camera, and it all played."

Initially, the Terminus set was to be built in a quarry about 25 miles outside of Limerick, Ireland. "We had the rock background that suited the location, but the time of year we were shooting, it started to get wet," reveals Conor Dennison, supervising art director. "The quarry was 50 feet below ground level and the whole thing flooded," he continues, "There was a massive emergency scout with David Goyer and Rory. We had built the whole city in the studio in Limerick with a view of moving it out to the quarry. Just before Christmas we got the news, 'We're going to go Fuerteventura.' We had to pack everything into almost 50 50-foot containers, and that was just before COVID-19 kicked in. About a month and a half later the whole world locked down. Those set pieces were still on the ship in mid-transit, so they got locked into a harbor over in Rotterdam. You could write a book about what happened behind the scenes on this one! We literally closed the shop and studio for three months. During those three months, they figured out a way of getting the ships out of Rotterdam and back over to Fuerteventura. We did manage to get the construction crew from Ireland over to Fuerteventura as well and then they had eight weeks to put the whole thing together."

A pivotal story arc involves the mysterious Invictus, a lost spaceship that becomes a weapon of mass destruction. "We took up half of D Stage to built Invictus, which is the old ship they come across towards the series' end," remarks Dennison, who subsequently groans when asked if the corridors were repurposed. "You've watched science fiction too much! We did. Invictus is meant to be a massive ship. The design philosophy behind it was that Trantor, which was the main planet where the show's three antiheroes rule, is meant to be a multilayered planet where over the centuries, layer after layer is built on top of the previous layer. Rory came up with the idea that visually, on certain levels, you would have old, seriously heavy concrete architecture like you would find in Germany."

"The **Invictus** is a Brutalist ship constructed out of concrete. There are a series of long fights along all of ship's the corridors. One corridor is normal, and another is covered in snow and ice. We dressed one place to look like the other one, switched the doors around, changed the signage and hung dummies from the ceiling to make it look like a continuation of the same ship."

The enormous Invictus proved a major, and challenging, part of DNEG's work on the series. "It is one and a half kilometers wide and three kilometers in diameter," notes Steven Moor, CG supervisor, DNEG. "The tricky part of the build was the fact that traditionally you would treat something like that as a vehicle. But because of the scale and how close we would get into that particular asset, we had to treat it as an environment. The catch here is it's an environment that actually moves around. There are components that spin wildly. In the old workflow you would build an entire mesh and have it moving in a shot, then you would cache that as a sequence of files. But because of the scale, the amount of detail, and the memory footprint, there was no way you could cache that. So, we developed a rig and workflow where we would build the ship in sections, instance the section, and flip them around to create the whole design of the ship. Then we would layer in some additional detail on top of that in Houdini to scatter the points. We would add a lot of additional detail in Clarisse so you would get the finest surface details."

"We had to come up with a way to drag that live inside our 3D software, so we created a rig that layout could use in May. They would drive the position and speed. Then we would have to figure out how to get that information from Maya to Clarisse so that all the scatter on top of the ship moved with the base. It was a workflow challenge and there was a lot of custom stuff going on in there. It was a good challenge that turned out well."

6. Nicolas Hernandez – VFX Supervisor – Important Looking Pirates - The Art of VFX

02/12/2021

Back in 2014, Nicolas Hernandez explained the work of Milk VFX on Hercules. Then he went to work on movies such as Ex Machina, The Martian, Fantastic Beasts and Where to Find Them and Annihilation.

How did you and Important Looking Pirates get involved on this show?

ILP started to work on Foundation in December 2019. The show was led and Supervised by Niklas Ström back then, and had to pause all work in August 2020 as the Production halted due to the pandemic. Shot production finally resumed in April 2021 and that's when I got involved.

What was your feeling to work on an such an iconic show?

Foundation was a highly rewarding project for me. It was a small size show with an intimate core crew but we had a great mix of creative challenges and involvement. It was a privilege to contribute and be part of such an ambitious show.

How was the collaboration with VFX Supervisors Chris MacLean and Mike Enriquez?

Working with Chris and Mike was an idyllic experience – they perfectly translated the Executives and Showrunners vision, gave us support and were always on hand to answer any questions.

What were their expectations and approach about the visual effects?

Both VFX Supervisors gave us specific briefs but were also welcoming and open to ideas and suggestions. They supported and understood the intentions of rough work in progress, and were never unreasonable with their feedback.

How did you organize the work with your VFX Producer?

I felt very lucky to have worked with the Production Manager Kajsa Kurtén and Executive Producer Måns Björklund. They both worked their magic making sure the project and the team were sailing in the right direction. Kajsa did most of the show planning, and once we agreed about milestones we religiously tried to stick to the plan.

What are the sequences made by Important Looking Pirates?

ILP worked on most of the shots involving the planet Synnax, seen from space, from a terrestrial point of view and underwater.

Can you elaborate about the design and the creation of Synnax?

For the rings, we dissected all the resources available from the Cassini–Huygens space research mission exploring Saturn's System. The groundbreaking images were a great inspiration for the rings. We also collected references from Nasa's pictures of nebulas and star maps. For the water and the sky we also collected lots of references for paradisiac islands. We really tried to build a coherent universe and created some VFX grounded to reality.

What kind of references and influences did you receive for Synnax?

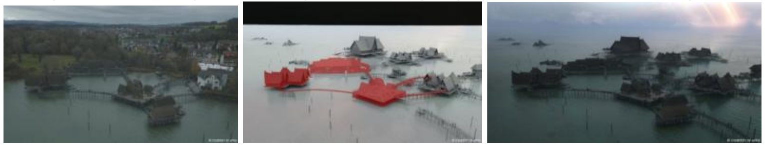
Production shared with us the Foundation's art bible. This gave us a good understanding of the visual intention of the show. ILP did some early concepts and RnD before turnover.

How was filmed the sequences on Synnax and especially with the people walking on the water?

To introduce Synnax in Episode 1, a portion of the village was practically built in Germany. The set was super impressive and gave us some very valuable references for the CG build. Later on in the episode, Gaal is on her way to Trantor and in Episode 10 when she is back on her flooded planet – Both were filmed in a water tank in Malta. In every instance and as a bare minimum we had to extend the water to infinity, and replace the sky.

Can you tell us more about the village creation?

We received extensive reference photography from the practical set build and photogrammetry from drone data – we extended in a logical way what was built. Adrian Tsang, ILP Build Supervisor, orchestrated the whole workflow. The Build team created a library of individual assets: walkways, platforms, houses, stairs, canoes, fishing ropes, props and so on. The whole village layout was done using proxy geometry then exported as point cloud to light, where the proxy geometry was swapped to high resolution geometry. In parallel each asset was detailed, and random props and ropes were scattered throughout the whole layout whilst Houdini proceduralism facilitated the task. Finally we added CG villagers, walking, chatting and hanging out in the CG village.



ILP has a huge experience with water. How does that help you on this series?

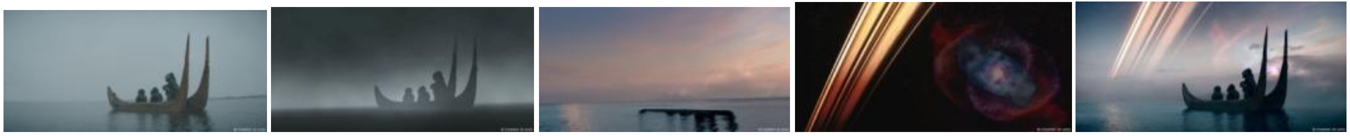
Indeed ILP has got a great expertise and a solid pipeline to deal with the challenges of CG water. Houdini is the main package for Scene assembly for FX and Lighting so the workflow is streamlined and very efficient. We used and improved ILP's ocean toolset for the project, and added some very neat new features.

How did you handle the water simulations?

Most of the shots involving Synnax ocean extension were handled by Lighting, using ILP's ocean toolset – with the ability to control wave/wind speed and scale, cross wind and mix multiple water descriptions for water breakup. But, for more complex shots, such as the sea sirens interacting with the water surface, Gaal's crypod splashdown, or the giant wave we required custom water simulation. The interactive water was simulated using houdini Flip solver. Multiple FX layers were generated: meshed water splash, white water, underwater bubbles and wet maps.

Can you elaborate about the creation of the beautiful sky and the rings?

Perspective, light and shading were very important in order to create beautiful reflections so we decided to create each component in 3D instead of a more traditional DMP workflow. The rings were made of little rocks scattered along curves, the skies were a mix of HDRI's and hundreds of individual clouds as VDB scattered in the distance. The ring, clouds, atmospheric, pocket of vapour, background nebula, starfield were all in fact 3D elements. Also as the landscape was seen under different lighting scenarios (night, sunset, daylight, overcast) this modular approach gave us the ability to manipulate the mood in a very organic way.



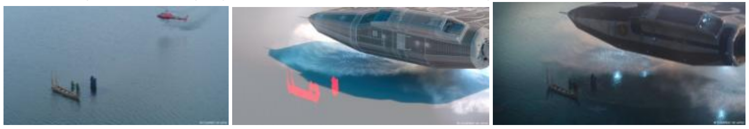
How did you manage the lighting work?

As rendering water is pretty expensive, the Lighting Team which was Supervised by Erik Johansson, in tandem with the Compositing Team, lead by Comp Supervisor Victor Sanchez, brainstormed a very nice workflow. The sky 3D components (ring, bg / mg clouds, sky position and intensity) were baked out as 360 render layers. Once the shots were tracked, Comp did a layout mockup of the sky by translating, rotating and grading each layer. It gave us a super quick preview of the sky so we could sanity check if the sequence worked in context of the cut. Once approved the 2D sky layout was exported back to light for rendering of the water. As the planet is solely made of water we knew that the reflection from the environment would be essential and the collaboration of Lighters and Compositors was very successful.

How did you create the underwater creatures and the ship?

The sea sirens were the stars of the Synnax's creatures, their design was inspired by stingrays with alien addons, and the fishes were a mix of baby hammer shark and barreleye. Subtle details like translucent skin and iridescent textures were added to make them otherworldly. The creatures were hand animated but the motion of the school of fish was driven by particle simulation. One anecdotal story, for a lot of shots we often suggested adding sea sirens, even if very subtle, to make the universe more coherent.

The ships and cryopod base model were provided – variations, paint job and alterations were handled by ILP.



Which shot or sequence was the most challenging?

The giant wave sequence for ep105 was quite challenging as it was tricky to tell the story mostly in one shot. We had to start again and go back to layout a few times to improve the shots execution. Also it was quite a challenge to light as the shot was backlit by the moon, and a realistic shader wave is hard to control.

Is there something specific that gives you some really short nights?

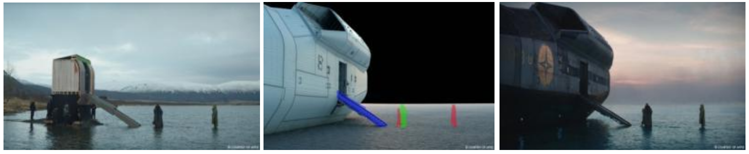
The mix of wonderful clients, skilled teams and strong planning helped me have the best night a VFX Supervisor could dream of.

What is your favorite shot or sequence?

I am proud of all the shots, but if I have to choose, I would pick the sequence of Gall returning to Synnax in episode 10. I just loved the look of it, dramatic and eerie.

What is your best memory on this show?

All of it really! The combination of working with collaborative nice clients and the over talented pirates crew made it an amazing and exciting ride. It was a special experience for me as it was my first show after joining ILP.



How long have you worked on this show?

In total, almost 6 months.

What's the VFX shots count?

We worked on 89 shots across 3 Episodes.

ILP was also involved in doing the previsualisation on a few sequences for episode 10 before filming which became shots that we later worked on.

What was the size of your team?

We had a core team of 6 during most of the project ramping up which became 12 during our delivery crunch time.

What is your next project?

I am currently working on a crazy cool sequence for a Netflix show and also starting to prep ahead for some exciting confidential projects for 2022.

7. Outpost VFX - Visual effects for film and high-end TV

Producer: Tom Barber, Danielle Malambri, Gez Hixson. Supervisor: Illia Afanasiev, Chris Faczek, Cale Pugh

- The long-awaited adaptation of Foundation, Isaac Asimov's influential sci-fi saga, premiered in late September 2021. After many attempts from various filmmakers to bring the story to our screens, David S. Goyer was able to finally wrangle Foundation's multiple plotlines spanning multiple centuries into a streaming series for Apple TV+.
- "Foundation presented us with a broad range of creative challenges, from simple de-aging comps, full CG environments, character animation and complex FX simulations."
- Outpost VFX Supervisor, Illia Afanasiev, details just some of the work required to breathe life into the visually stunning and complex universe within which Foundation takes place.
- "Our key focus was expansive CG environments, notably the Maiden Moon's Salt Palace and surrounding landscape, the Surah planetary satellite system and the Cleon palace hallway."
- The plot of Foundation follows Dr Hari Seldon (Jared Harris), a mathematician and psychologist, who spends his career developing a psychohistory theory that can predict the future of humankind.
- When Seldon prophesises the fall of the Galactic Empire, he and a team of scientists and engineers must fight the chaos that follows, preserving science and knowledge for future generations.
- While Goyer remains true to many story points in the original material, the showrunner has added some new elements to the story, making it more relatable to today's audience. This sprawling, multifaceted storyline takes place across the galaxy, making for visually breath-taking intergalactic environments.
- "Perhaps our biggest environment was the Maiden Moon; a barren salt desert landscape with an isolated ancient palace called the Salt Palace" says Afanasiev.
- "For the Salt Palace and surrounding environment, we filmed on location at Fort Manoel in Malta and used references from an archaeological site in Petra, Jordan and in Egypt."
- "In some shots we used set extensions to build the palace, and in the wider establishers we used a full CG version of the Salt Palace set within its desert landscape," adds VFX Producer Tom Barber.
- "The salt desert environment itself was a combination of a CG build with DMP enhancements, kept alive with FX dust trails, a lot of 2D atmosphere and cloud gobo lighting. The landscape was often populated with religious pilgrims which required crowd extensions, CG simulation for wide shots and the use of 2D green screen elements for close ups," Afanasiev recalls.

- “It was extremely important to us and the client that we created believable and realistic VFX that would bring the Foundation universe to life.
- “When we were building and designing Surah – the huge gas giant that Maiden orbits – as well as its additional orbiting moons, we had calls with a very helpful scientist from the JPL at NASA to maintain scientific accuracy. We used Jupiter and its moons as a reference point and went from there.”
- Barber details some of the CG asset work the team delivered for Foundation: “We had several full CG sequences with spaceships too. For example, the Emperor’s ship – the Rubicon – arriving and departing from the Salt Palace, the Foundation when it arrives at Terminus as well as the Foundation Tower as it lands on the surface of the planet and the larger Deliverance ship as it crash-lands nearby.”
- The team also work on the Demerzel character augmentation. Afanasiev says: “the gruesome character work of Demerzel was a challenge, but the end result looked great on delivery.” That’s all we’ll say on that front for now…
- Outpost were awarded a little over 250 shots which were delivered across all studios. With season 2 already in motion, we can’t wait to see what the adaptation of the novels continues to bring.

8. FOUNDATION | RodeoFX - From construction to destruction and back again

- For its first collaboration with Apple TV, the Rodeo FX team was asked to help bring the award-winning novel from Isaac Asimov to life in the first season of this groundbreaking new space opera: *Foundation*.
- With the entire shooting delayed by COVID-19, and the delivery date only 5 months away, our team had to develop brand new processes to bring this project to life. Working closer than ever before with the client, the daunting task was a fun, new challenge for our team: destroy not only entire cities but a planet, too. Thus creating the Trantor scar, a pivotal plot twist of the entire show.
- Built upon extensive research on wreckages, explosions, and earthquakes, the team was able to render what will become throughout the entire season a major component of the planet’s landscape. On Trantor, the cities are immensely dense, pushing the team to create giant areas modelled after places like Hong Kong or London…except 20 times bigger. Different levels of destruction also had to be applied to the buildings thus creating a scale from “intact” to “entirely destroyed” for each of them along the scar. The team also worked on a second critical destruction: the Aegis ship crash, another FX masterpiece entirely done digitally.
- While the first collaboration with a new client is always challenging, the quick pace and incredible opportunities forged between Rodeo and the team at Apple proved to be a powerful and valuable bond. In fact, it opened the doors to the second season where our team will continue exploring the fall of the Galactic Empire.

9. How Apple design influenced the hit TV series

By Ian Dean (ImagineFX) published October 07, 2021

Discover the concept art behind Foundation, Apple's hit TV series. Acclaimed concept artist Stephan Martinière shared the designs he created for Foundation, how he created the iconic sets and spaceships of the latest hit show. Martinière is a Hugo-award winning illustrator and concept artist. portfolio website

A revised concept for the space station seen in Foundation

Where do you begin when starting a project like Foundation?

Each vision for the film project I am working on is driven by either the director or the production designer. It starts with a conversation about what the vision or look wants to be and what is important to convey in each concept and the overall ideas. Directors and production designer know my work and are always looking for what I can bring to complement the vision and offer unique or compelling ideas. It’s also about offering concepts that can trigger new narrative possibilities.

A concept design for a Trantor street from Foundation

Foundation inspired Star Wars, did Star Wars now inspire Foundation?

It’s an interesting question. From a thematic perspective you can certainly see how Foundation inspired Star Wars but Asimov also mentioned that the main concepts of the Foundation series also borrow from actual ancient history. These main ideas don’t dictate a specific visual and scripts don’t tend to be visually descriptive which leaves the director, production designer and concept artist to come up with something interesting.

It’s always a challenge as more and more sci-fi films are being made and creating a unique visual signature becomes harder but there are still plenty of interesting visual ideas to come up with unique visuals. One of them being proposed was to use the Apple sleek design and try to carry it in some of the ship looks. Another was to give the Anacreons a very unique tribal look loosely based on the Polynesian designs. There was also a very specific architectural direction for some of the environments.

What have been the broad influences on key scenes and concepts?

Modern concrete architecture with a monolithic and geometric design, characteristics of brutalism was some of the main architectural influences for the [Trantor] Palace. It was an interesting choice that felt appropriate and representative of the empire's rigidity.

The Anacreon ship design has been inspired by tribal patterns

What considerations does good concept art need to have?

A good concept can do many things depending on what that concept is. The requirements for an environment might be very different from a vehicle or a costume. It’s not about just looking cool. As a concept artist I try first to understand the narrative intent of the concept; what it needs to convey.

Take the Anacreon ship for example. The early concepts were very aggressive and sleek in their design. They were cool but too modern and did not fit the narrative of an ancient, feudal and warlike society. Incorporating tribal designs into their technology helped give the Anacreons a unique visual signature but also clearly established the right narrative. Using tribal design also helped me define the general shape of the ship. It became clear that using a simpler and less sophisticated look would work better like the front part of the ship looking like two ancient carved wood shields. Does it need to look like it can it work? I would say I have seen hundreds of different designs for space ships and I don’t think anyone worries about that. Even transformers make you believe the impossible.

It’s different for a costume or a weapon, at least some weapons. The crossbow is a good example. I had to think of a design that could be functional if the weapon was going to be a hand held practical prop. If it’s not it still need to be design for the mechanical part to work. The simpler solution is to make a cool shape and have it fire a laser beam that works too.

The wrist bow needed to reflect the book's description, look good, and be workable for the actor (Image credit: Apple TV + / Stephan Martiniere) Concept art for Foundation was a mix of 2D and 3D

Do you approach designing a gun or ship in a different way to an environment?

Each concept needs to convey different things or solve specific problems but there is always a narrative being them. An environment tends to require more thinking. There is the composition, the mood, lighting, and the design. Sometimes there are multiple narratives in one single shot which make it more challenging. A ship is more direct but still need to have all the proper elements to feel right and fit the story.

For this project I use 3D much more than usual. I like doing that when certain designs are complex or need to be very precise like ship design and weapons or the palace interior. There is also a different creating process I like when using 3D. It allows me to come up with intricate shapes that would be very difficult to conceive in 2D. The lighting is also important and using 3D makes it a lot easier. I usually built 60 to 80% in 3D and finish the concepts in Photoshop.

Do you need to be up to speed on the latest science to create believable concept art?

It's important to do a lot of research to keep up with all trends, not just science. As an environment artist I need to know what the trends are in architecture and technology. As a costume designer I need to follow what the fashion industry is doing. As a weapon or vehicle designer I also need to know what the newest design trends or new thinking are. It’s not so much about believable design more than it is about using the trends as a springboard to create unique and compelling concepts.

10. Rory Cheyne on designing ‘Foundation’ around the world

“My team in Toronto became this design team on the outlying planet ‘Toronto-terminus’. They found an office, supplies and set up for the next 6 months. Some of the Toronto team joined me in Iceland and Ireland. As the show continued, I had to set up design departments in Ireland, Iceland, Berlin, Malta, and the Canaries. It was truly an amazing experience and I think everyone in these art departments formed some lifelong friendships all over the world.”

Apple TV+’s epic new science fiction drama series *Foundation*, based on the series of novels by legendary author Isaac Asimov, recently premiered on September 24th. The series, set in the far future, follows a band of exiles on their journey to save humanity and rebuild civilization amid the fall of the Galactic Empire and dire warnings from a scientist who can see the future. We spoke with DGC Ontario Member Rory Cheyne, the Production Designer of this ambitious and hugely-scaled series, about getting the call that would change his life, an entire set flying off an Icelandic mountain, and how he worked simultaneously with remote teams in Toronto and across Europe to bring the world of *Foundation* to life.

Tell us how you became involved with this production.

I say sometimes you cross paths with people for a reason. Becoming part of *Foundation* was like that. Chris Maclean (VFX Supervisor) and I had tackled season 2 of *American Gods* a year prior. Chris was the second hire and had mentioned my name in a boardroom in LA. Then I was in the mix. I then met with David Goyer (*Foundation* showrunner) and was handed two scripts. I had a week to put an overall concept together for the series and head to LA for a series of interviews with Skydance and Apple creatives. I got a call a week later while standing in my kitchen staring at my wife, and our life was about to change more than we could ever imagine. “Can you get on a plane tomorrow and scout Iceland and Europe?” I then had two weeks to scout Iceland, Ireland, and Germany, and present an overall plan to Apple for the series.

How did you make sure you remained true to the aesthetic of Asimov’s work?

The visual aesthetic of Asimov has been interpreted by many movies, series and sci-fi artists before me. It was a daunting task to follow artists like Foss, Barlowe, and films like *2001: A Space Odyssey*. I watched a lot of sci-fi, filtered through the *Foundation* books and pinned up as much sci-fi art I could find. I was after the ‘space’ between what I feel is classic sci-fi and contemporary sci-fi films from the past 30 years.

What were some of your favourite setpieces designed for the show?

I would live in Salvor’s outpost. That set travelled to three countries: mountain top in Iceland (which at one point blew off the mountain during a storm), the interior was in a studio in Ireland, and its final resting spot was on a mountain in the Canaries.

You were working on Foundation overseas in multiple locations, bringing some Art Directors with you while some of your team remained in Toronto. Take us through that experience and what it was like.

The show started during probably the busiest time in the industry worldwide I’ve ever seen. I had an almost impossible delivery date for the designs. I had a team of designers on *Locke and Key* S1 ready and excited to tackle *Foundation*. My team in Toronto became this design team on the outlying planet ‘Toronto-terminus’. They found an office, supplies and set up for the next 6 months. Some of the Toronto team joined me in Iceland and Ireland. As the show continued, I had to set up design departments in Ireland, Iceland, Berlin, Malta, and the Canaries. I spent my time balancing between them all. I have a lot of AirMiles now.

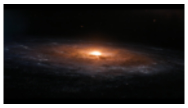
It was truly an amazing experience and I think everyone in these art departments formed some lifelong friendships all over the world. I really tried to sew everyone and their ideas together on this project. One special person I have to talk about is Hank Gay. He was the thread that brought everyone together. When we started filming the pilot, Hank wanted to go on set and art direct. He was on that mountain in Iceland. He was on location in Berlin. He made sure the studios in Ireland shot the right way. He was in Germany on location when the world shut down. The crew in every country bonded with Hank. He was our star.

What do you love most about working in Toronto/Ontario?

The level of professionalism is unparalleled. The depth of the design departments has become more and more advanced since I started in the late 90s, from 3D modelling, VR set design, illustrators, and industrial design. We need to keep up this knowledge base and push further to compete worldwide.

11. Behind the ships of Foundation (2021) - Now completed | The Spaceshipper on Patreon

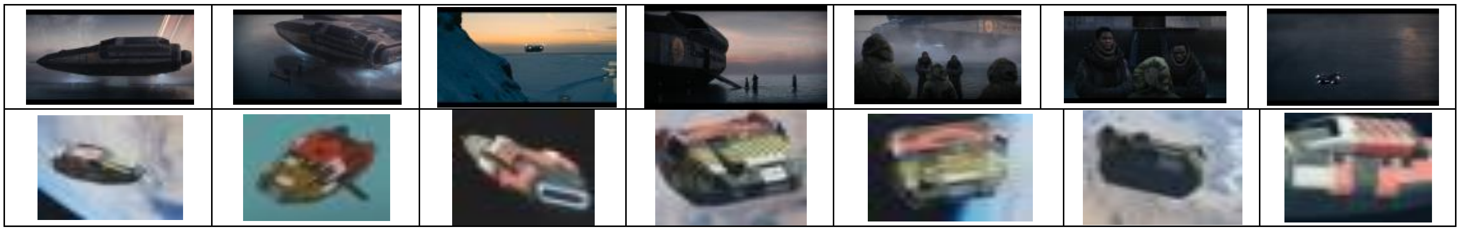
UPDATE 11/14/2021: BTS pics, artworks and explanations by production designer Rory Cheyne



Ships that we risk seeing for several years to come, given that S2 has been approved and eight seasons / 80 episodes are hoped for, at best. Warm thanks to production designer **Rory Cheyne** for his answers, to **Ian Failes** (**Befores & Afters**) and **Vincent Frei** (**Art of VFX**) for allowing me to tell this *Foundation ships oral history*. Please note than an artbook is planned, at an unknown date (2022 at best).

STO (surface to orbit) Transport: Terminus Blue Team and Synnax Shuttles

This ship appears from the start, on Synnax. It is into it that Gaal Dornick's adventure begins. The talented **Paul Chadeisson**, who worked on **Remember Me, Strike Vector, Missions, Blade Runner: Black Out 2022, Cyberpunk 2077** and **Homeworld 3**, participated in its creation. 3D concept by **Paul Chadeisson**.



VFX Supervisor **Chris Maclean: "***Designs were by Rory Cheyne, the Production Designer, concepts were done by Wayne and Paul, yes.*"

Chris Maclean (Art of VFX): "*We hired a lot of great concept artists, like Paul Chadeisson and* ***Wayne Haag*** *to help with the ships and fleshing out the worlds*. (...) *What if we took the grounded reality of Interstellar or* Gravity *and then introduced the technicolor punch of a 70's Sci-Fi cover like a Chris Foss, Michael Whelan or John Berkey*."

Production designer **Rory Cheyne** (DGC Ontario): "*The visual aesthetic of Asimov has been interpreted by many movies, series and sci-fi artists before me. It was a daunting task to follow artists like Foss, Barlowe, and films like* ***2001: A Space Odyssey****. I watched a lot of sci-fi, filtered through the Foundation books and pinned up as much sci-fi art I could find. I was after the 'space' between what I feel is classic sci-fi and contemporary sci-fi films from the past 30 years.*"

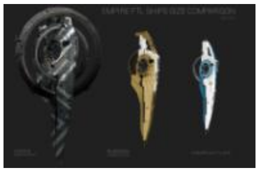
Showrunner, writer and producer **David S. Goyer** (*Dark City, the Dark knight, Vader Immortal*) to 3D World Magazine: "*We told them, 'It's not going to be like any of those things'.*" These things being **Star Wars, Alien and Star Trek**, the holy space trinity. "*But if you don't have anything to point to at the beginning it becomes daunting to develop the visual language. We kept coming back to 'What's something we haven't seen before? What's something that is iconic? What's a shape that feels simple?'*"

Chris MacLean (Befores & Afters): "*When it came to the visuals, [David] had opinions, but it was really up to production designer* ***Rory Cheyne*** *and I to come up with everything and go, 'Okay, how do we do this show without making it look like another Star Trek, or another Star Wars?' What we ended up doing is taking reality and mixing it with 70s sci-fi cover art, basically—all the old novel covers and just amp'ing up the saturation a little bit and trying to take NASA footage and mix it with that. That was the mantra we came up with*."

Rory Cheyne: "*These are short-distance shuttles, like taxis, that move people and products between the planet and the waiting FTL transport ship in the upper atmosphere.*"

Paul Chadeisson: "*The colours ended different but the shape is still there! Super proud how it turned in the show*."

Imperial FTL Ships (including knife ships, battleships, Imperial shuttles and the Rubicon)



Production designer **Rory Cheyne:** "*FTL is an acronym for faster than light. The FTL ships are pride and joy of the Empire. They provide the ability to travel through the galaxy at incredible speed, and to establish an authoritarian rule over other planets.*"

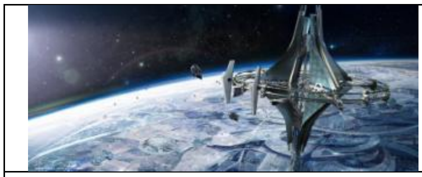
Art by Art director **Jeremy Gillespie** (*The Expanse, Star Trek Discovery, The Boys*). Dorwin is now the name of an Imperial Commander. He commands one of these battleships, the Aegis.

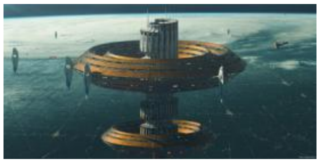
FTL (faster-than-light) Jump ship (commercial/Transport FTL)

It is this type of ship that allows people to travel through an Empire encompassing the entire galaxy. **Paul Chadeisson** created the first version of this design, then other artists tweaked it. I will clarify when I know more.

VFX Supervisor **Chris Maclean** (Art of VFX): "*We would start from those simple ideas and then flesh them out from there with the concept artists and design teams(...) If you look at the design language of the ships they are all based on basic primitive shapes or based on a simple idea. The FTL ships are knife blades that cut through space and time.*"

Showrunner **David S. Goyer** to 3D World Magazine: "*What I tried to do in the script is to at least emotionally describe the effect, because I always come from a place of story. The Empire is aggressive and male so I wanted their ships to be like knives, which meant that they weren't just folding space but ripping it.*"

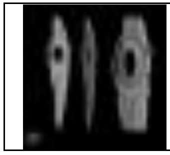




An older version of this design in this concept art of the Star Bridge by **Stephan Martiniere** **(***Independence Day, Tomorrowland, Age of Ultron, Guardians of the Galaxy, Tron: Legacy, Star Trek, Star Wars, Knowing, Ready Player One, The Fifth Element, Red Planet, Titan A.E.)*

Concept artist **Stephan Martinière** (ImagineFX): "*It's always a challenge as more and more sci-fi films are being made and creating a unique visual signature becomes harder but there are still plenty of interesting visual ideas to come up with unique visuals. One of them being proposed was to use the Apple sleek design and try to carry it in some of the ship looks.*"

Another Star Bridge concept art, later in the production, by **Paul Chadeisson**.



Here is a 3D model done in October 2019 by Assistant Art Director **Karl Crosby**, who worked on the whole six seasons of **The Expanse, Killjoys, Dark Matter** and the upcoming space-set TV series **Beacon 23**.

Karl Crosby: "*VFX also did many of the ships as physical 3d models- I got to develop the FTL ships for print*."

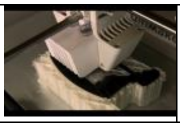
A practical model was made by **Odyssey Studios**, in Limerick, Ireland.

Chris Maclean (Art of VFX): "*From the outset I had a very good idea of how to execute the show from a FX standpoint but also wanted to pay homage to Sci-Fi that came before us. I wanted to look at melding practical and digital elements in an elegant way. That's where we decided to shoot miniatures and cloud tank elements as a starting point.*"

"*The ships were designed and then we decided which ones we wanted to build practically and which ones we wanted to do exclusively in CG. We really wanted to do them all as miniatures but time and budget wouldn't allow for it. We also realized that given the accelerated delivery and Covid restrictions, we would have to do more digitally. The ships we did build as miniatures were 3D printed and then we lit them internally with LEDs.*"

Chris Maclean: "*We brought* ***Ian Hunter*** *(****Interstellar****) on to help us realize this. We wanted to design shots that felt grounded in reality and the best way to do that was to actually shoot them.* ***Mark Maher*** *and his team at Odyssey Studios built the FTL ship, The Rubicon, The Aegis and The Beggar's Lament under Ian's supervision. Ian then brought in a motion control team and* ***Les Bernstein*** *to shoot the miniatures. For me, it was amazing to learn about this process and to be a part of it. These guys are truly dedicated artists and I loved every minute of it. In the end, the footage of the ships were invaluable as shot elements but also as reference for the full CG ship shots.*"

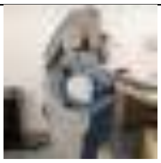
Odyssey was tasked with one of it's biggest builds to date: "*The VFX team proposed to shoot miniature model spaceships in order to create the high quaility and vfx intensive shots that were needed. This was a homage of sorts to productions which had used this technique in the past.*"

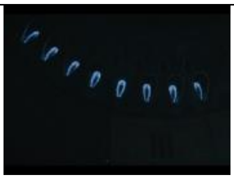


Ian Hunter: "*We start with concept art, turning it into a digital model.*" "*We can then translate that digital model into a file that we can use to 3-D print.*" "*So we're taking the digital asset and turning it into a physical asset.*"

Chris MacLean (Befores & Afters): "*In fact, a lot of times we shot something and ended up going fully CG anyway, but we would give the plates to the vendors as reference. (...) You know, one thing I hate more than anything is when a camera doesn't feel real. Where you get a CG camera and it's doing 360s, moving a million miles a minute. There's no weight to it and all that sort of thing. So, our idea behind that was, we would have the ship, we would have the motion control rig, we would have the camera, and we take that option to move the camera in a crazy way away. It means you are locked into this world where you have to figure out the moves in a realistic way. What we found was that we could move a lot slower and it would feel more real*."

Ciarán Cooke, studio manager at **Odyssey Studios**: "*Odyssey Studios is one of Europe's largest permanent model making facilities. We do everything from design and digital modelling right through to fabrication, all in house (...) But primarily, we worked as the miniature model makers for the VFX Dept. Many of the spaceships seen in the show are actually miniature models made right here in studio.*"





Odyssey Studios: "*This was the first of the VFX miniatures we made for Foundation. Seen in episode one, the FTL serves as the commercial interstellar "jump ship" for the series.*"

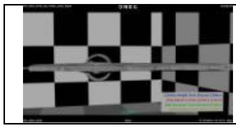
Chris Maclean: "*Odyssey Studios built the FTL ship, The Rubicon, The Aegis and The Beggar's Lament.....For me, it was amazing to learn about the process and to be part of it. These guys are truly dedicated artists and I loved every minute of it. In the end, the footage of the ships was invaluable.*"

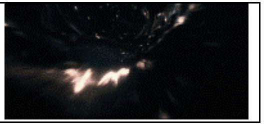
Rory Cheyne: "*Something we needed to figure out was how passengers would be seated or held in place during FTL travel on the ships. I came up with the idea of a type of mesh that would lock you into position and send you to sleep for the journey. I first looked at the aquatic* **.** *Some subspecies catch prey by shooting forth a sticky, weblike substance that Wikipedia describes as 'a mass of sticky spaghetti.'*"

"I thought some version of this projectile, biological mesh would be an interesting type of protection for FTL travel. However, this concept proved too difficult and costly, so I turned to a type of medical mesh that is used to keep patients steady during MRI scanning."

Odyssey Studios: "*Originally 3D printed, the base body was mould and cast to create a hollow housing for the internal wiring. The full DMX controlled RGBW LED lighting system included individual circuts for interior cockpit, cabin, headlinghts, engines, navigation, surface lights and fibre optics.*
There were also three hidden mounting points to allow the ship to be shot from any angle. All the footage was captured using a large model mover as part of a motion capture rig." Not everything was done using models. It is about using each technology, each tool according to the needs of the shot.

Here is a CGI shot by **Double Negative**, under the supervision of **Chris Keller** (**Geostorm, Pacific Rim Uprising**):





The Jump technology is considered by the Empire as a state secret. It is the Empire which masters it in order to reign over the galaxy, since no one else has this technology without appealing to the Empire.

Note that the horizontal position of the ship is purely for a visual/cinematic function, b/c as **Chris MacLean** reminds us, "*the rotation of the ship was more for aesthetics and aspect ratio... No real 'up' in space... It leaves Synnax horizontally and arrives at Trantor vertically*."

Chris MacLean (Art of VFX): "*The expectations were astronomically high for Foundation. We were inventing a new Sci-Fi visual language. What does FTL travel look like?*"

Chris MacLean (Art of VFX): "*I think one of the coolest ship design moments was when Rory and I came up with how we were going to visualize FTL travel. We were watching a lot of Sci-Fi movies at the time and we kept going back to Interstellar for how grounded it was in reality.*"

"We had an "Aha!" moment, what if the ship generates its own singularity and folds space! I took this to Chris Keller and the team at DNEG started riffing on it. It became our perfect moment to do an homage to some of the Sci-Fi visionaries of the past but also to make something of our own."

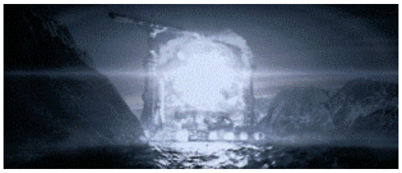
Chris MacLean (Art of VFX): "*For the FTL jump we were like, ok, DNEG knows how to do singularities and black holes ala Chris Nolan and* ***Paul Franklin****. Then I got thinking of folding space and kept going back to the slit scan sequence Doug Trumbull's effects for 2001: A Space Odyssey.*"

"*I thought to myself what would that look like if we did that today? We shot some high speed wire wool elements that inspired some of the streamer effects. We introduced some smoky multicolored plasma. Once we put all this together… man, it was just so fucking cool (...) We showed this to David Goyer and he was blown away.*"

Chris MacLean (Befores & Afters): "*That came from a mix of what Asimov wrote about travel, and then us wanting to riff on an ode to sci-fi. Overall it came from D. Goyer's description of the FTL ships as knife blades cutting through space. We then thought, let's have the ships generate their own singularity and cut through space. So, the black hole, obviously that's inspired by Chris Nolan and what Paul Franklin, at DNEG, had done on Interstellar. There they came up with the black hole simulator. And luckily those shots were sitting at DNEG, so we were like, 'Hey guys, what can we do here…?'*"

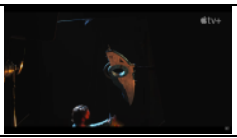
Chris Keller, VFX supervisor, **DNEG** (3D World Magazine): "*We wanted to create something that had all of the natural phenomenon that people would recognise. The logic behind the FTL ship and the Invictus later is that they create an extremely high energy field in the centre that collapses into a singularity. It's like a mini black hole that folds space time into this trippy looking smoke trail.*"

Chris MacLean (Befores & Afters): "***Paul Franklin*** [**Interstellar**] *actually got involved for those shots because we were having a little bit of trouble with blocking. It was just really great to be able to build that up and make it and see what we had originally set out to do come to life.*"
Chris Keller: "*We made it a dreamy, almost psychological effect. Whenever the spaceships appear we're already at the destination and this bubble opens up and the ship pops out. The ship drags along with it some of that smoke and spark elements which we did using wire wool.*"

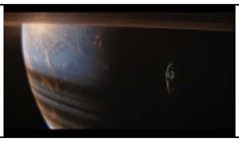


One might think that the **Contact** (Robert Zemeckis, 1997) machine was one of the sources of inspiration, but this is not the case.
VFX Supervisor **Chris MacLean:** "*To be honest we never looked at Contact as reference but it must have been buried deep in our subconscious... For the rings I kept going back to the desktop magnetic solar systems we had in the 80s and early 90s*."

Photographing this model with a motion control camera:



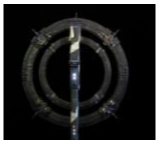
Finally, some details of the ship:



FTL Jump ship: The Aeagis and other warships (Battle FTL)

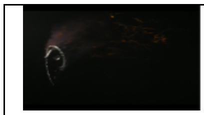
The Aegis of the imperial Navy, like the other models of this kind, has two additional perpendicular rings and a consequent armament. The aegis is "the power to protect, control, or support something or someone. In ancient Greek mythology, an aegis was something that offered physical protection. In some stories, it was the thundercloud where Zeus kept the thunderbolts he used as weapons."

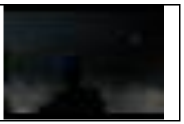
Same design & creation process as the previous ship. Once the design was validated, **Karl Crosby** made it into a 3D model which was used by **Odyssey Studios**.
Odyssey Studios: "*The imperial war ship. It retained the same basic bladed shape of the FTL, a reference to the fact it is also a Faster Than Light vehicle. This was more complicated build, the concentric rings gave the ship much more volume, not to mention the omni directional gun turrets. On screen, the Aegis is many times larger than the FTL, though both models stood about 5" tall, this meant the surface detail on the Aegis needed to be much smaller to scale with the ship.*"



Motion control photography

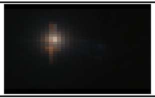
The model or CGIs or both were used depending on the needs of each shot. Rodeo FX took on the Aegis VFX.
Chris Maclean (Art of VFX): "*For the Anacreon and Thespin attacks in episode two we used a combination of CG and miniature elements to create the sequence*." These ships are capable of entering the atmosphere.





FTL Imperial Jump ship: the Rubicon (personal jumpship of the Empire)

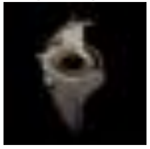
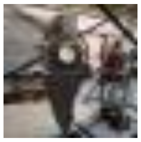
It is the imperial version of the Jump ship. Similar to the commercial version, but much more luxurious. It is reserved for the Cleons, obviously.

	by **Wayne Haag**	by Paul Chadeisson			On screen:	
						

The Rubicon is "a bounding or limiting line, especially **:** one that when crossed commits a person irrevocably". And you know, the "river of northern Italy forming part of the boundary between Cisalpine Gaul and Italy whose crossing by Julius Caesar in 49 b.c. was regarded by the Senate as an act of war."

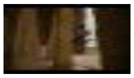
Outpost VFX were responsible for the Rubicon.

Outpost VFX Supervisor **Illia Afanasiev**: *"It was an honour to work on Foundation. I'm extremely proud of the work we did at Outpost. From expansive environments to epic space shots and gruesome character work, it was a fun ride."*

Its golden paint reflects the function of this ship. And it's a third practical model by **Odyssey Studios**:

Odyssey Studios: "*Again, this ship was also derived from the basic FTL shape but with slightly different scale to the surface detail. This ship had far more details added to set it appart as the royal transport. Adorned with with gold decals and some serious artillary, this ship contained as similar DMX controlled LED system to the FTL and Aegis*."

Details of the hull:					

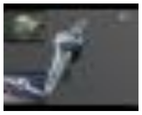
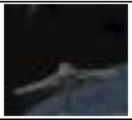
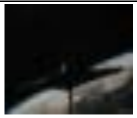
The Imperial Shuttle

The Cleons & political dignitaries move on/around Trantor w/ this shuttle. The wings fold up when the ship lands.

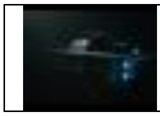
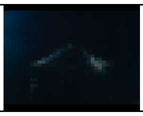
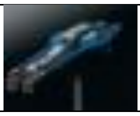
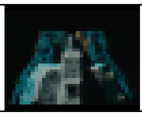
Chris MacLean (Art of VFX): "*The Imperial Shuttle is a switchblade.*"

Concept art by **Stephan Martinière** (ImagineFX): "*Each vision for the film project I am working on is driven by either the director or the production designer. It starts with a conversation about what the vision or look wants to be and what is important to convey in each concept and the overall ideas.*"

Stephan Martinière (ImagineFX): "*For this project I use 3D much more than usual. I like doing that when certain designs are complex or need to be very precise (...) It allows me to come up with intricate shapes that would be very difficult to conceive in 2D. The lighting is also important and using 3D makes it a lot easier. I usually built 60 to 80% in 3D and finish the concepts in Photoshop.*"

3D model:		Shot with a CG model		One shuttle for each Cleon			
							

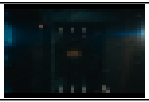
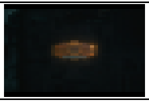
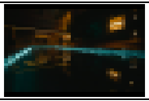
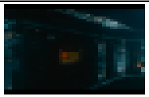
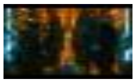
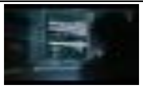
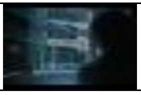
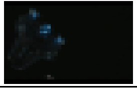
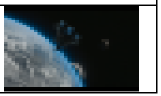
Deliverance (Imperative-class)

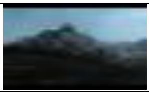
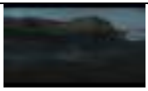
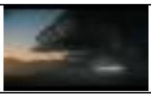
This slow ship, which takes Hari Seldon and his followers to Terminus, is not a Jump ship. The journey takes four years.

Rory Cheyne: "Deliverance *is an Imperial freighter, analogous in purpose to a 21st-century container ship, except that instead of sailing with cargo around the world, it flies its freight around the galaxy*."

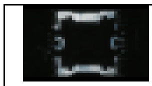
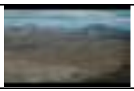
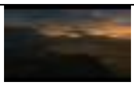
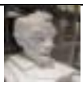
Its name is taken from a Hari Seldon quote in the first episode: “Math is never just numbers. In the wrong hands, it’s a weapon. In the right hands, deliverance.” I don't remember if this sentence is taken from the books.
Design-wise, the Deliverance is a "long haul tuning fork" according to **Chris MacLean.**
Fortunately, the 1,710 crew members have a swimming pool in the aft part of the ship. There is a garden too.
Paul Chadeisson worked on the design of this ship. Mackevision did the Deliverance slow ship work.

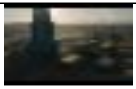
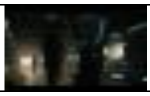
At the end of the journey, the crew crush the Deliverance on Terminus, in order to retrieve materials to build the Foundation. It will thus be stripped over the following decades. Art by **Paul Chadeisson**.

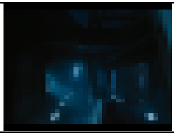
But most of Seldon's loyalists had landed at Terminus using the lower part of the Deliverance, which is in fact a self-contained ship.
Rory Cheyne: "*In the case of Deliverance, we decided that the ship had been cannibalized architecturally when it landed on Terminus, its parts used to make the structures of Terminus City. One thought I had was that its containers could be jettisoned to the surface in order to start the city build. Also the rudder of the Deliverance would become the tower of Terminus. The carcass of the ship would then become something for the children of Terminus to explore.*"
This is how the Deliverance is at the very origin of the Foundation: its lower part is the central tower, and the wreck was used to build the colony.

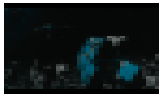
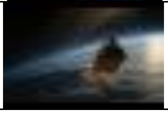
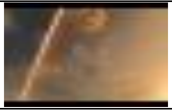
Please note that the statue of Seldon was also created by **Odyssey Studios.**
I salute the extent to which this series - whose history will span several centuries - has been designed to keep its actors, and its sets. Thus the Deliverance is visited at various times. Do you remember the pool window? Obviously, we find this set in the part of the Deliverance which has become the tower of the colony.

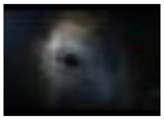
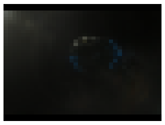
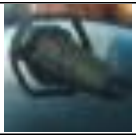
Deliverance corridor, by **Karl Crosby**. Sets that we will see again in the coming seasons.

Deliverance's Cryopod

				Mackevision did the Cryopod.		
						

The Raven

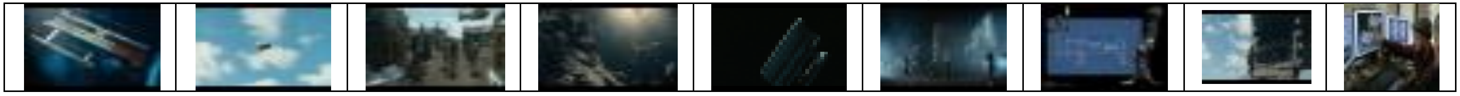
							Initial sketch /Art by **Paul Chadeisson**
							

Raven, an automatic, unmanned ship, is Hari Seldon's nickname in Isaac Asimov's novels.
Rory Cheyne: "*Raven is an autonomous ship, waiting for Hari Seldon's consciousness to be downloaded. A windowless ship with the ability to take extreme temperatures.*" Buf did some space exteriors and **Raven** shots, both exterior and interior. This ship looks very modern, very sleek, even to **Foundation**.

Rory Cheyne: "*A big part of the practical design and build of the set was to incorporate programable lighting. I wanted Gaal to wake up the ship through her moments. When she moves the lights move or follow her.*"
The visual influence of **2001: A space Odyssey** (1968), **Oblivion** (2013) and all this stylistic family is felt.
This part will be updated after the end of the broadcast of the first season.

The Beggar's Lament

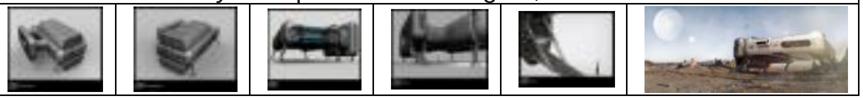
The Beggar, owned by the trader Hugo, is a bit like Foundation's Millennium Falcon. This ship transports goods between the different planets in the Terminus sector. Unfortunately, the most beautiful shots of this ships are not shareable. Yet. Fortunately, there is no shortage of behind-the-scenes footage, as you will soon discover.



Rory Cheyne: "*Like the Thespin Lancers, this Thespin tech ship is bound to its pilot. Beggar's Lament is the spacefaring equivalent of a long-haul truck, designed to carry containers to be delivered to far-off worlds.*"
Chris Maclean:"*The Beggar's Lament is a galactic bush plane, like one that might deliver people and goods to Alaska.*"

by **Paul Chadeisson**

Karl Crosby transposed it to 3D again,in November 2019



Rory Cheyne: "*For Beggar's Lament, I wanted to create a different and unique shape and distinct from other movie spacecraft. The ship is two stories high, with multiple access points.*" **Odyssey Studios** was to make a new model.

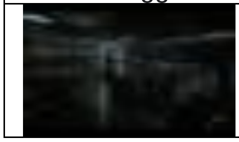
New colour pass by Assistant art director **Aaron Morrison**

Odyssey Studios: "*In concept, the Beggars was much more of an interplanetary cargo ship as opposed to the intertellar jump ships of the FTL fleet. Though much smaller than the FTL in the show, the model scale of the Beggars was much larger. At this scale, every single tiny detail was vital.*"

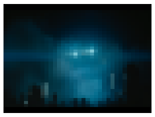
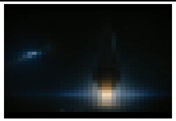
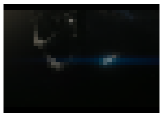
Odyssey Studios: "*This was a special ship to our whole team, everyone had a hand it. Initally we pondered the design, so industrial it almost seemed dated compared with the FTL, despite the fact we are still so far from this kind of technology. Slowly but surely, the Beggars won everyone over. So much character, so practical, the level of detail in the painting, the texture, the sublime lighting design. It really felt like this model could take off at any moment.*"
This model is superbly detailed.

Chris Maclean (Art of VFX): "*We shot them the same way you would render a shot. The vendor would deliver animation pass based on tech vis that would run the motion control camera rig and model mover. We would do a beauty pass, individual lighting pass i.e. engines, running lights, key light, back light. Then we did a utility matte pass. We got quite a bit of great footage.*"
"*We then digitized all of the practical models we built of the ships, scanned them and took texture photos. These were then given to the vendors as data sets to build the fully digital versions of the shots. Like I said, we didn't do this for all of the ships but it help keep us grounded in reality.*"

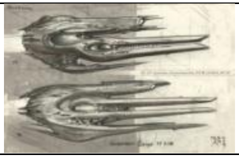
For Ciarán Cooke, studio manager at **Odyssey Studios**, the best part of this project was "*finally seeing our work on screen. It was a long wait from beginning the project in 2018, to finally seeing the fruits of our labour, especially when you can't tell anyone what you've been doing. The VFX in the show are outstanding, we may have built the ships but Chris MacLean and his team made them fly.*"

Beggar's Lament bridge:			No joystick here:	And some corridors:	
					

Rory Cheyne: "I *knew from the start that we'd be spending a lot of time on Beggar's Lament in Season 1, and likely even more in Season 2, so the ship needed to be structured in a way that could grow with the series.*"

Art by **Bartol Rendulic**:						
						

Anacreon Corvettes

	Early design by **Bartol Rendulic:**		**Stephan Martinière**	
				

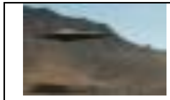
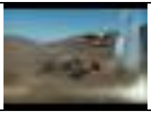
Rory Cheyne: "*These are warships covered in a type of wood-based armor.*"

Stephan Martinière (ImagineFX): One interesting idea was "*to give the Anacreons a very unique tribal look loosely based on the Polynesian designs*. *The early concepts were very aggressive and sleek in their design. They were cool but too modern and did not fit the narrative of an ancient, feudal and warlike society. Incorporating tribal designs into their technology helped give the Anacreons a unique visual signature but also clearly established the right narrative. Using tribal design also helped me define the general shape of the ship. It became clear that using a simpler and less sophisticated look would work better like the front part of the ship looking like two ancient carved wood shields.*"
"*Does it need to look like it can it work? I would say I have seen hundreds of different designs for space ships and I don't think anyone worries about that. Even transformers make you believe the impossible*."

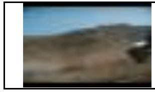
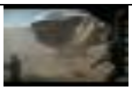
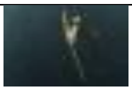
	from afar ...		in hologram ...		then...

Thespin Lancer Ship

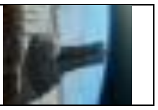
This ship has mechanical parts that allow it to land with grace. Art by **Paul Chadeisson**.

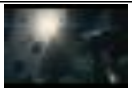
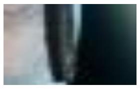
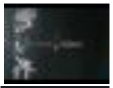
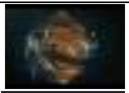
Rory Cheyne: "*Like the Beggar's Lament, Thespin fighters are remote-controlled by on-planet pilots. Each pilot and ship are bonded, so the ship can only be piloted by a single individual, and that pilot cannot be untethered from the ship, even if they are physically separate*."

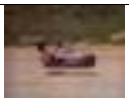
Imperial FTL ship: The Invictus

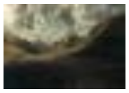
This 700 years old "ghost" warship - equipped with a FTL drive - was in the back half of the season.				

Art by **Paul Chadeisson**. It was one of the first task Paul had to work on for *Foundation*.
Rory Cheyne: "*The Invictus is an ancient Imperial battleship with 700-year-old FTL tech, a giant juggernaut that can fire in every direction. Approximately 1km across in diameter*."
It comes from a storyline taken from *The Mayors*, the third novella in the *Foundation* novel. In the book, a Prince from Anacreon recovers an old, powerful Imperial cruiser.
Chris Maclean (Art of VFX): "*DNEG was our volume vendor and did most of the heavy lifting. They were responsible for the FTL travel sequence, Starbridge collapse, the* ***Invictus****...*"

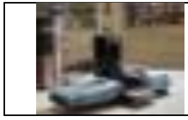
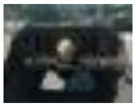
				Art by Assistant art director **Barbara Agbaje**				
								
								

Bonus: Terminus Hover Car

	Production designer **Rory Cheyne:** "*This is my homage to Luke Skywalker's landspeeder. The design is utilitarian: if Terminus had a Land Rover dealership, this was our Defender*."		

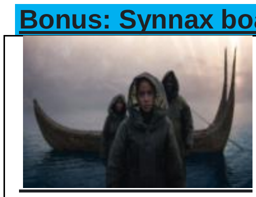
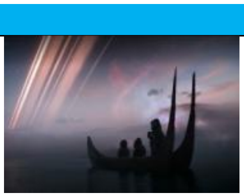
by **Paul Chadeisson**		by **Bartol Rendulic**	On location	Plans/elevations		by **Wayne Haag**	
							

Pics by **Rory Cheyne**:

Rory Cheyne: "*The do all vehicle for the Foundation. Design influences can come from many places. Terminus hover car dashboard was a marriage between a 70s camaro and the space shuttles ceramic tiles*".
Conor Dennison, supervising art director, to 3D World Magazine: "*We got a dune buggy from Germany and brought it back to Limerick. We cut it down the middle, stretched the whole thing out for an extra 10 to 15 feet, put in a new roll cage, new hydraulics, and built an Aircar sitting on top of it. One driver was facing forward and the other facing backwards underneath looking at the actor overhead. When they were going to the left the pneumatics were set up in such a way that it would go to the right, so the actor would go the right way*."

Bonus: Synnax boat

	Art by **Karl Crosby**:			

We end with an artwork of the Trantor library as imagined by **Wayne Haag** (**The Fifth Element, Alien Covenant**).
Foundation: Season 1 credits
Production Designer: Rory Cheyne
VFX producer: Addie Manis
On-set VFX Producer: Sarah Vinson & Victoria Keeling
Senior VP of Visual Effects at Skydance: Kathy Chasen-Hay
22 VFX vendors shared the 3,900 shots of this first season.

Kathy Chasen-Hay to 3D World Magazine: "*I realised early on that we needed a second visual effects supervisor because there was such an overlap between physical production and post-production, and the different time zones. Chris MacLean couldn't be available while he was supervising on set and was a large component on the creative side in physical production. Michael Enriquez came in and carried the post and burden of vendor communication*."

Davis S. Goyer